

Full Throttle

June/July 1998

Volume 5 Number 3

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REVIEWS

- Pacific Islands Scenery
- Scenery South America
- Scenery China
- VIP Classic Wings
- Propellerhead Panels

Global Positioning Satellites

Guide to 3D Video Cards

Profile—Garmin Industries

Making Custom Textures

The Last Super Constellation Airliner



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helicopter, a machine that's guaranteed to make you feel like a rookie all over again.



Your coordinates for take-off are www.microsoft.com/games/fsim

Dear Flight Simulator Enthusiast,

This is already our third issue but it seems like we've been doing this forever! Trying to learn the magazine publishing business has been an interesting exercise.

In just a few short months, we've been able to pull together an experienced and expert group of professional and dedicated writers, artists, and

publishing managers to assemble a dizzying number of articles, notes, memos and emails into a cohesive and hopefully readable magazine.

Judging from your early feedback, we have at least a few satisfied readers among you. Below, we've printed a few of the comments that we've received

recently. As always, we welcome your comments – both good and bad.

Happy Flying,

Arnie Lee



"I would like to congratulate you on your first issue of Full Throttle - I read it cover to cover. ...you hit all my buttons with this issue" - from H.W. of Arizona.

"As a long time 'old timer' flight simmer, I pass along a 'very well done' and count on me to be a long time subscriber". - from W.D. via the Internet

"Your NOTAMs: New Products is a winner. Very comprehensive and informative" – from M.G. via the Internet

"I was very pleased with the change. .. I'm glad to say that when my renewal comes around here shortly my check will be in the mail. Sorry I don't have anything really constructive to add except maybe More More More !" - from K.B via email.

"I really like the new look of the magazine. ... All the articles are informative and a pleasure to read. ... You folks have done a tremendous job of breathing new life ... Keep up the good work and looking forward to staying with your magazine for many years to come." - from R.vB. - via email.

"Your first issue just arrived and it is the best ever. ... I just ordered two new scenery packs after reading about them in your Product Reviews". – from M.M. via the Internet

"What a wonderful surprise when I received my new Full Throttle magazine. ... This is more of what we need - up to date reviews, how to columns with useful content, and good web links. I am very pleased with what I see in this first issue and I hope to read many more in the years to come. This is what we need!" - from B.D. of Cleveland, OH.

"Your idea of reviewing software will save me a bundle. I buy everything that comes out, and I can't really afford it." – from J.S. via the Internet

"... I thought the new edition was excellent. I'm glad I kept my subscription. Keep up the good work". - from B.W. of Clermont, FL.

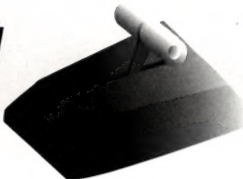
"... this issue that you folks have produced has been the most impressive yet. It feels like I'm getting my dollar value and plan on continuing with the subscription". - from R.H. of Calgary, ALB

"Like your review of simulators other than FS98 (which I really like), it is nice to see what else is available. ... I can see it turning into a must have magazine for flight simulator hobbyist". - from S.M. of Long Beach, CA

"I am very impressed and just had to write you to let you know that the improvements are enormous. The layout is excellent, the articles are superb and I particularly like the NOTAMS. ... You and your fine staff and contributors obviously know what is required in an FS magazine". - from T.vS. by email

"I have read every article in the issue and all were great. Congratulations on the mag and I look forward to the next issue!" - from G.Z. by email

Full Throttle



Contents for June-July 1998

NOTAMs - New Products 4

Recent and upcoming software and hardware.

Basics Of 3-D Technology 10

3-D Hardware For PC-based Flight Simulation 14

Painting Scenery Textures for MS Flight Simulator 26

Designing and Making Scenery 33

Homebuilders Corner 37

The Last Flying Super Constellation Airliner 42

Global Positioning Satellites 48

Garmin at a Glance 51

Shareware Registration Center 54

Experiencing The Ultimate Airliner Simulation 56

A Round Robin Adventure 59

PhD—Propellerhead Design Panels for FS98 64

Reviews 67

Pacific Islands - from Pilots, GmbH
Escenario Suramerica Andes - from Playsoft
VIP Classic Wings - from The PC Aviator Pty Ltd
Scenery China & More - from Aerosoft
German Airports I - from Aerosoft

Internet Sites for Simmers 77

Adam Howe presents this months pick of great flight sim web sites.

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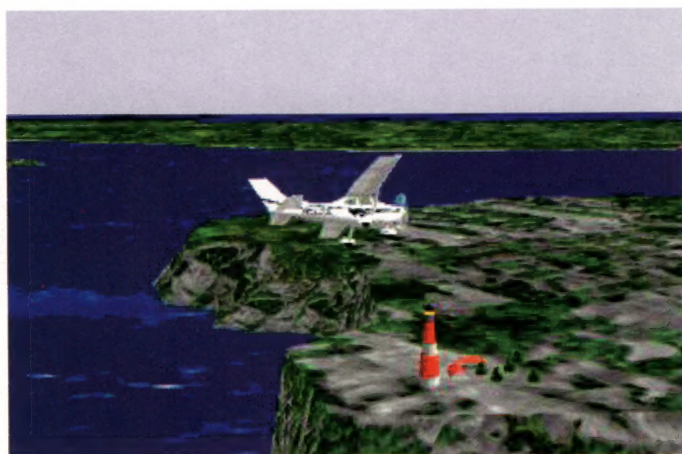
NOTAMs: New Products

For those of you who aren't familiar with the term, NOTAMs is an acronym for NOTices to AirMen. The U.S. Government issues NOTAMs on a regular basis. This issue marks the launch of our version of NOTAMS — an expanded new products section. It will be a regular part of our magazine. The products listed are compiled from press releases and information provided to us by the respective authors and companies who supply the products. We've taken steps to verify the information with each author or company, but cannot be responsible for inaccurate features, specification or availability dates.

Sweden Scenery

New Swedflight 2.0

A group of talented scenery designers have recently completed scenery of Sweden. Called "Swedflight," it covers the entire country including thousands of mountains, lakes, rivers, islands, roads and coastline. **Swedflight 2.0** includes all 180 airports in this large Scandinavian country. According to coauthor Bengt Larsson, many of the textures were custom designed to emphasize the natural environment.



Swedflight 2.0 is also compatible with the famous Norway 6.1 scenery which was made by some of the same designers.

Swedflight 2.0	
For FS5.1, FS95 and FS98	
SRP:	Freeware download from Swedflight Web site
From:	Swedflight
http://www.dialnet.se/~swed	
E-mail:	findell@dialnet.se

MicroWINGS Conference

"The" Flight Sim Gathering

If you'd like to meet the movers and shakers in the flight simulation world and discuss your favorite pastime, consider attending the upcoming MicroWINGS Flight Simulation Conference. It's scheduled for August 20-23 in Orlando, Florida.



As with past conferences, MicroWINGS President Robert Mackay will bring together many well-known flight sim personalities, software developers, hardware manufacturers, aviation vendors and very enthusiastic flight sim users. The conference includes dozens of presentations, demonstrations, group discussions and question and answer forums.

This year's conference will be held at the Clarion Resort in Orlando, which Mackay calls the "Silicon Valley of the South." Orlando is home to DisneyWorld and Universal Studios—two leading-edge simulation giants.

For the latest information about the conference, check the MicroWINGS Web site.

MicroWINGS Conference	
From:	Robert Mackay MicroWINGS 381 Casa Linda Plaza, #154 Dallas, TX 75218
Phone:	214-324-1406
Fax:	214-324-1406
http://www.microwings.com	
E-mail:	fltsim@microwings.com

Scenery Queensland

Australia's Sunshine State

PC Aviator, the flight sim add-on publisher based in Melbourne, Australia has recently released **Scenery Queensland**, covering more than 1.7 million beautiful square km down under.

Scenery Queensland's expansive area stretches across this north-eastern state and features some of the most famous Australian sites such as Cairns, Brisbane, The Gold Coast, the Great Barrier Reef and many of the famous resort islands. Some 140 airports and complete nav aids let you fly from the Pacific coast to the rugged outback.



Scenery Queensland	
For Microsoft FS 5.1, FS95 and FS98	
SRP:	About \$49.00
From:	PC Aviator 219 Balaclava Road Suite 6 North Caulfield, VIC 3161 Australia
Phone:	+ 3-9532-8258
Fax:	+ 3-9532-8916
http://www.pcaviator.co.au	
E-mail:	crew@pcaviator.com

FS Action! Scenery

Animate Flight Simulator

Abacus, the "sister company" of *Full Throttle*, announces the upcoming release of **FS Action! Scenery** developed by Louis Sinclair in cooperation with Trancer Software. This new easy-to-use program lets you add animated objects to your static scenery.

First, use the built-in FS video recorder to record a flight path. **FS Action! Scenery** lets you quickly edit or modify this path, select any of the included objects and define other characteristics for your animation. When you're all done, the new dynamic scenery is automatically created and you can immediately see the new moving vehicles when you start Flight Simulator again.

In addition to FS95 and FS98's built-in dynamic scenery objects, **FS Action! Scenery** includes brand new moving vehicles created with Konstantin Krushkin's DynKit. (available June 1998)



FS Action! Scenery	
For Microsoft FS95 and FS98	
SRP:	\$39.95
From:	Abacus 5370 52nd Street SE Grand Rapids, MI 49512
Phone:	800-451-4319
Fax:	616-698-0325
http://www.abacuspublisher.com	
E-mail:	sales@abacuspublisher.com

ProFlight 98

Utilities for FS98

AETI has announced **ProFlight 98**, a set of utilities for FS98. ProFlight 98 lets you:

- ➔ Create digitized-voiced adventures using info from a database of 20,000 airports, waypoints and nav aids.
- ➔ Fly the adventures using a Flight Management Computer which can be used with the new Learjet and B-737 panels.
- ➔ Customize FS aircraft adding new trim colors, new airlines liveries, and new panels using the Aircraft Personalization Wizard.
- ➔ Use the new B-777-300 aircraft with a new *glass cockpit*



ProFlight 98	
For Microsoft FS98	
SRP:	\$49.95
From:	AETI 3972 Barranca Pkwy Suite J-501 Irvine, CA 92606
Phone:	714-551-0372
Fax:	714-551-2695
http://www.simpilot.com	
E-mail:	sales@simpilot.com

Twilight "Value Pac"

Unique CD-ROM Package

Twilight Express of Tokyo, Japan has released a new package for MS Flight Sim users called **Value Pac**. This unique package has lots of "goodies" for flight simmers.



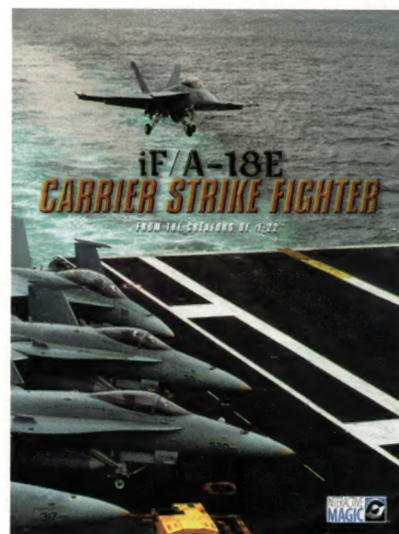
Included in this innovative package are a circular navigation "computer," full-color VFR Terminal Chart of the Chicago area, handy "Object" maps of several cities that facilitate "sightseeing" by plane, a printed pad of navigation log sheets for flight planning, an authentic ATC-voice adventure from Meigs to Kankakee and four new aircraft: Northwest A320, United B747-200, American MD-11 and Delta MD-90.

FS95 Value Pac	
For: FS95 and FS98	
SRP:	About \$39.00
From:	Twilight Express SK Building 2-16-4, Minami-Ikebukuro Toshima-ku Tokyo, JAPAN
Phone:	+ 3-5979-7496
Fax:	+ 571-245-3956
http://www.twilight.co.jp	
E-mail:	twilight@twilight.co.jp

iF/A-18E

Carrier Strike Fighter

Interactive Magic has released their latest aircraft simulation, this one based on the carrier-based F/A-81E Super Hornet. The new **iF/A-18E** uses Interactive Magic's TALON—Total Air and Land Operations Network—system that generates an unlimited number of unique, true-to-life missions.



Other features include a point-and-click cockpit that makes it easy to use and set the instrumentation. After you're catapulted from the flight deck, you'll fly in realistic terrain derived from real-world elevation data and satellite images. **iF/A-18E** also supports modem and network missions.

iF/A-18E Carrier Strike Fighter	
Available: Summer 98	
SRP:	About \$59.95
From:	Interactive Magic P.O. Box 13491 Research Triangle Park, NC 27709
Phone:	919 461-0722
Fax:	919 461-0723
http://www.imagicgames.com	
E-mail:	lbeaman@imagicgames.com

Europe 3

Apollo's England Scenery

Apollo Software of Munich Germany and distribution partner AETI have released the newest in their Europe series, entitled **Europe 3**.

Europe 3 covers the area of Great Britain below the 54th parallel, which includes England, Wales, the Channel Islands and the Isles of Scilly. In all, Europe 3 has more than 100 airports, buildings, rivers, lakes and mountains. In addition to famous landmarks such as the Tower Bridge, Tower of London and the White Cliffs of Dover, you'll also view castles, factories and lighthouses.



Europe 3	
For Microsoft FS 5.1, FS95 and FS98	
SRP:	\$59.00
From:	Apollo Software/AETI 3972 Barranca Parkway Suite J-501 Irvine, CA 92606
Phone:	714 551-0372
Fax:	714 551-2695
http://www.simpilot.com	
E-mail:	aeti@simflight.com

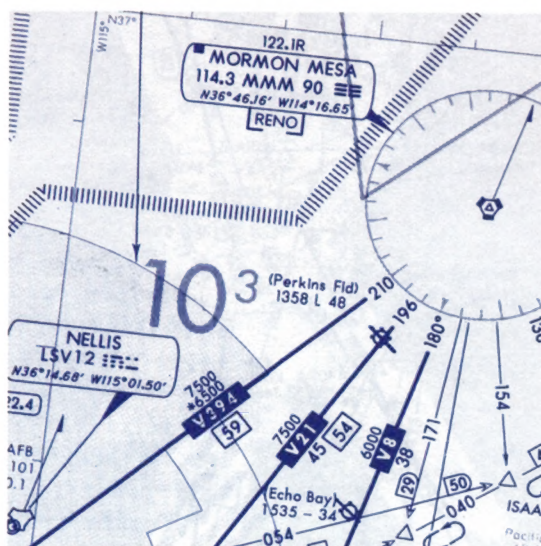


IFR Color Atlas

A Desktop Wings Book



For simmers who like flying IFR, Desktop Wings has just published its new IFR Atlas. The **IFR Atlas** is a 246-page book derived from the 27 Low Altitude Enroute Charts covering the continental United States. The charts are same-scale reproductions of the NOS originals formatted to fit in the 11-inch square pages. For added convenience, pages are spiral bound and lie flat when open.



Information depicted on the charts includes VORs, NDBs, airport locations, Victor airways (below 18,000 feet), intersections and holding patterns. Routes contain mileages, minimum enroute altitude, minimum obstacle clearance altitude, minimum reception altitude and navaid and ATC frequencies.

Separately, Desktop Wings has also published an improved edition of their VFR Atlas. This is a 228-page spiral bound volume also in full color.

IFR Atlas and VFR Atlas	
For any flight sim enthusiast and FS98	
SRP:	\$19.95 (IFR Atlas) \$39.95 (VFR Atlas)
From:	Desktop Wings P.O. Box 422 Dublin, PA 18917
Phone:	800 848-6198 / 215 453-9312
Fax:	215 453-0286
http://www.design-web.com/DesktopWings	
E-mail:	bpoor@netreach.net

Airfield

Adventures in Europe

Papa Tango, the U.K.-based publisher of flight sim add-ons such as FSFX and Real ATC, has released its newest package: **Airfield**. Two years in the making, **Airfield** has more than 300 airports and strips in Western Europe—an area spanning France, Luxembourg, Belgium and Switzerland.



According to the company, **Airfield** uses textures created with their *Technology 2 Textureal* for the landbase, buildings and mountains. All waypoints and nav aids for these areas are included, making the scenery suitable for IFR operations.

In addition, **Airfield** has new aircraft: C130 Hercules, P3 Orion, PC6 Porter, DHC6-300 and Berijev BE12. The documentation features full-size maps and charts for both VFR and IFR navigation and airport approach plates.

Airfield	
For Microsoft FS95 and FS98	
SRP	\$39.95
From	PapaTango 15 Home Farm Luton Hoo Estate Luton Bedfordshire LU1 3RD United Kingdom
Phone:	+ 1582-615 333
Fax:	+ 1525-454 974
http://www.papatango.com	
E-mail:	katie@papatango.com

Dangerous Airports

New Theme Scenery from Abacus

Abacus has announced the second in its series of *theme scenery*. Instead of presenting expansive scenery areas, **Dangerous Airports** puts you in the left-hand seat at some of the toughest approaches in the world.



Scenery designers Tim Dickens and Jim Rhoads have teamed up to create the challenging and treacherous terrain at airports such as Innsbruck, Kathmandu, Lake Tekapo, Reykjavik, Sonderstrom and Funchal. Aircraft designer David Lewis has crafted a Cessna 421 twin, a Citation Business Jet, an ATR-42 and a Beaver Floater—planes that you'd operate in these regions. (Available July 1998)

Dangerous Airports	
For Microsoft FS98 only	
SRP:	\$39.95
From:	Abacus 5370 52nd Street SE Grand Rapids, MI 49512
Phone:	800-451-4319
Fax:	616-698-0325
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Navigation Computer

Use this hand-held, professional-spec navigation computer to make calculations for flight times, flight distances, fuel consumption and wind correction angles. Just like the pros!

Navigational Log Sheets(25)

Professionally record and archive the details of your flights on true-to-life log sheets. Everything is more realistic with Value Pack!

Object Map of Famous Cities

Be an expert in visually sightseeing the 16 most representative objects of three major cities visited with MS Flight Simulator: Chicago, London, Paris. Flight Video is provided to enjoy professional FS pilot flying in those cities. And the manual helps you to understand those flight in detail.

VFR Terminal Air Chart

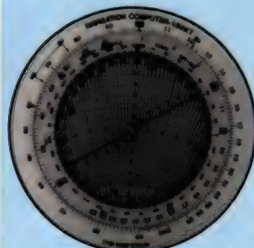
Learn to read and use this accuracy reproduced VFR map for Meigs Field, the home base airport of MS Flight Simulator. Details instructions included. Value Pack also provides cockpit videos of the actual Meigs take off, landing and more!

MEIGS Adventure

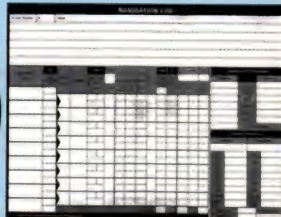
Fly an Air Traffic Control(ATC)adventure from Meigs Field in Chicago to Kankakee airport with the voice of real air traffic controller to direct you. The adventure even generate random engine failures, requiring you to occasionally make an emergency landing.

Major US Airlines (Aircraft collection)

Have nice flight on a Northwest A320, United B747-200, American Airlines MD-11, or a Delta Airlines MD-90



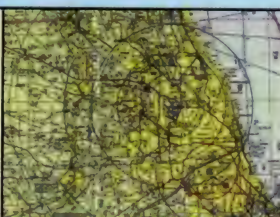
Navigation Computer



Navigational Log Sheets



Object Map of Famous Cities



VFR Terminal Air Chart



MEIGS Adventure

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High Flight

TEL: 619-675-4016 FAX: 619-675-4019
toll free: 1-888-247-3478 e-mail: sales@chsdist.com

Flight Sim Central

TEL: 800-477-7467 FAX: 615-754-4138
e-mail: 72662.3123@compuserve.com



Twilight Express

URL: <http://www.twilight.co.jp>

The Virtual Hanger

Readers Guide To 3D Technology

Basics Of 3-D Technology

By Bill Horscheit

3-D technology is one of the most exciting innovations flight simulators have embraced. It promises richer, more realistic images, exploiting the latest PC video hardware technologies. Though little doubt exists about its overall benefit, a barrage of new hardware, an expanded lexicon, and as many standards and features as pizza toppings leave many people confused. Dozens of products offer just as many performance and feature variations. Before diving headlong into uncharted waters, a fundamental understanding can dispel much of the hype and reveal which 3-D features and products offer the most significant benefits.

Most flight simulation enthusiasts are not typical "gamers." Many do not own a variety of other entertainment software. While many popular games have supported 3-D graphics for quite some time, most popular flight simulators have not. Only the most recent simulator versions tend to offer 3-D support. By virtue of time, gamers have had a chance to become more familiar with the technology and hardware. 3-D graphics may not be new, but its recent arrival in flight simulators has placed many simmers behind the learning curve.

But the curve isn't steep. There is not much to learn, nor is it difficult to understand. In fact, it isn't even necessary to understand 3-D graphics to enjoy its benefits. It is simply different than traditional 2-D graphics. A basic understanding can reduce much of the

Follow Bill Horscheit's primer on 3-D technology — one of the most exciting innovations for flight simulators

expense, ambiguity and potential frustration resulting from assumptions instead of facts. Furthermore, a little knowledge can go a long way toward ensuring you have the best possible 3-D-capable hardware and software outcomes.

What is 3-D?

The term "3-D graphics" describes a scene (video display) based on polygons, textures and perspectives, instead of pixels and shapes (2-D). Though this may seem to be complex at first, managing 3,000 polygons and 200 textures begins to look very efficient when compared to an 800x600 display's 480,000 pixels. Despite their differences, the end-images wind up in the same place. Because monitors are two dimensional, "3-D" describes how programs process the video information.

In contrast, 2-D (for the most part) means breaking down each frame's objects into their 2-D surfaces, translating each into its appropriate perspective to create new 2-D objects that appear in the final scene. As most surfaces contain a texture, the

conversion must process them as well. Suddenly, a square is not just a square. If the square represents the side of a brick house, each pixel of the image that simulates its bricks must be converted. All these complex conversions are necessary because the completed three-dimensional scene must ultimately appear on a two-dimensional monitor.

A 3-D world is much different; objects become the focus. Though processing 3-D objects begins with surfaces also, the similarity ends here. Instead of calculating how a two-dimensional surface equates to another two-dimensional object, to simulate three dimensions, the program can describe a surface in its actual state and the point of view. There is also no need to convert its textures. What was a series of complex equations and conversions becomes "create a polygon 'this' size, containing 'that' texture as seen from 'there.'" The focus shifts from determining an object's screen appearance to how it physically exists.



What Benefits Does 3-D Offer?

The first payback seems to favor the software developer by returning focus to a program's core features instead of complex geometry. This is only the tip of the iceberg and probably the least important consideration during game play. But when reducing the complexity and number of display instructions required, the application may use far fewer CPU cycles. It can reduce thousands of instructions to dozens. In the struggle to improve frame rates, this is no small accomplishment. As a result, programs can deliver scenes more efficiently, consistent with the scenery designer's intentions.

Most of these benefits are tangible, but perhaps the greatest benefit lies in their potential. Since programs make relatively few "final decisions" on the actual display image, programmers can strategically position images to incorporate many additional enhancements, which might be too complicated with 2-D graphics. Many of these enhancements already exist, but the most important benefit is that the architecture allows them to occur.

How Does 3-D Work?

While the tools differ, the process remains the same; programs issue instructions to hardware, expecting an image in return. The combination of programs and hardware require some means of understanding each other. Hardware vendors offer drivers, special programs that accept instructions and translate them to a device's native language. This allows the thousands of software and hardware combinations to work together. The operating system (e.g., Windows 95) is a common reference point for the two. It serves as a digital currency exchange. Regardless of 2-D or 3-D graphics, mice or printers, this principle enables programs and devices to communicate and creates any measure of compatibility.

3-D is relatively new and unique. The video display has always been a core PC feature and operating systems "grew up" supporting video hardware. However, with so many vendors implementing equally varied 3-D products and technologies, no prevailing standard exists. Many programs communicate using product-specific languages, like GLide and RRedline, while others favor some of the "open" languages (sometimes called "APIs," or Application Programming Interfaces) that support numerous cards, like Direct3-D and OpenGL. Lacking clearly defined features and

compatibility requires hardware and software supporting at least one common instruction set.

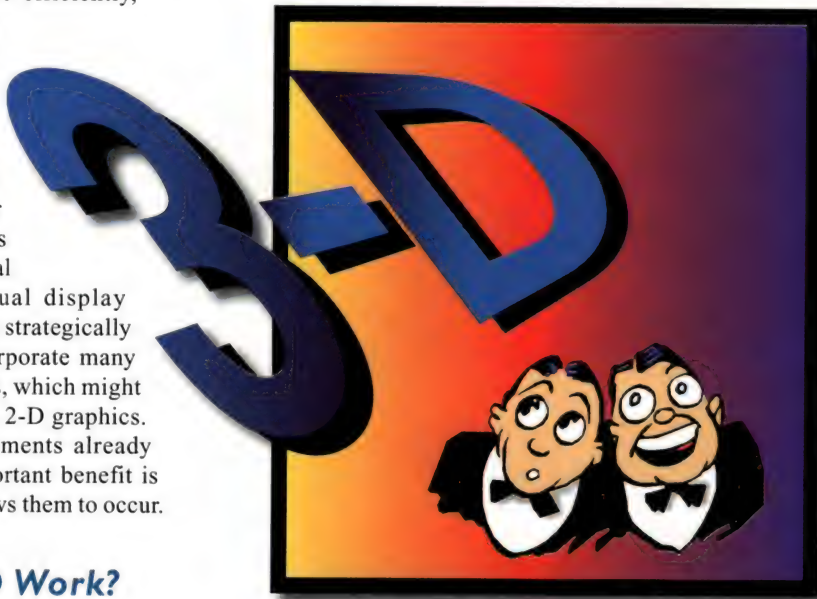
What is Hardware Acceleration?

The intent of 3-D graphics is to provide faster, more realistic scenes. Despite the academic discussion, if the program isn't generating these shapes and textures itself, such as a haze effect, then what is? Obviously, it lies somewhere outside the core application itself. Since there are many different approaches, there are equally as many different solutions. To render these scenes faster and more realistically, 3-D cards rely on hardware acceleration.

3-D cards do nothing that software can't. Given the right set of drivers, capable of translating the simple program commands into a video card's native language itself, there is no reason a typical 2-D card could not become fully 3-D compliant. Without hardware acceleration, 3-D does little more than transfer processing from the application to the drivers. It could support 3-D programs, but it would do little to improve speed. Hardware acceleration is the ability to "subcontract" these tasks to the 3-D card instead of relying on

the CPU. This defines the fundamental difference between *graphics cards*, and *graphics accelerators*.

Generally, two properties have the most influence over an accelerator's overall performance. First is its inherent speed. Just like CPUs themselves, each 3-D accelerator has its own speed capabilities. Second, and much more varied, is the number of supported features. The 3-D accelerator's physical architecture defines characteristics like texture memory and memory type, and also influences overall performance. Inherent speed and accelerated features are very significant. The wide variety of combinations accounts for the vast differences between many 3-D accelerators.



specifications, establishing a single universal instruction is not yet practical and remains far off in the distance.

Despite the variations, compatibility is significantly improving. As each program effectively translates its instructions into the 3-D-card's native language, each card vendor provides drivers supporting the APIs it chooses. Developers make similar choices. Most hardware and software vendors support at least one of the "open" languages in addition to their own. This may leave some users with incompatible software and hardware, but such instances are becoming less frequent. As both parties increase their API support, progress continues toward a universal instruction set. Until then,

3-D card vendors can also support certain features by software through drivers. Although this can add features beyond a 3-D card's core feature set, it does rely on the CPU resources instead of the 3-D card. The performance difference and feature quality greatly depends on the drivers. Different drivers can also affect the final image. As a result, cards with more robust hardware accelerated features tend to perform better. This also touches on 3-D graphics' second primary benefit, special effects that have never been feasible before.

3-D Features

Improved speed is reason enough to adopt 3-D. But 3-D accelerators also continue to develop new and more sophisticated effects. Support for these effects within the application programs vary. In a 2-D world, a square is a square, period. Regardless of the video card, 2-D scenes have always been very similar. Most 3-D processing occur within the driver and cards. Different accelerators and different drivers can produce very different results. Despite their variety, they all compliment the core 3-D polygon and texture concept. Though secondary in nature, special effects create some of the most profound attractions.

With all its variations, the term "3-D acceleration" has become much like the word "stereo." Both usually conjure something beyond their original meanings. Stereo doesn't just mean separating sounds into left and right. Unless it includes noise reduction, bass boost and other features, many would hardly consider it a "stereo." While it's easy to get lost in the bells and whistles, surround sound and solid bass can be the best parts. When weighing specific features, it's important to note if the effect is software or hardware supported. Though one is not automatically faster than the other, hardware support tends to offer better performance. The following list summarizes some common features.

Polygon Processing

This is the first 3-D processing step. Before all else, 3-D must see objects as polygon surfaces. Some cards refer to this as triangle setup, because they require seeing each polygon as a collection of triangles.

Anti-aliasing

Anti-aliasing removes the jagged edges created by monitors' grid-like pixels. Image processing programs like PhotoShop and Corel PhotoPaint use anti-aliasing to maintain resized images' smooth appearance. Its extremely processing-intensive nature has left this feature absent from most of today's 3-D accelerators.

MIP Mapping

To simulate focus, MIP Mapping allows foreground objects to be clearer and more distant objects to be less well defined. It varies texture resolutions and can improve performance for more distant, less precise objects.

Bilinear Filtering

Bilinear Filtering is a form of anti-aliasing. Instead of applying to object edges, it applies to the textures themselves. Trilinear filtering is also becoming more common. It also varies a texture's clarity based upon proximity. Because they share certain properties, trilinear filtering almost always requires MIP Mapping.

Perspective Correction

Realism requires both accurate geometric and texture perspectives. For example, a program might represent a railroad track as a rectangle with a wooden tie texture. When standing on the tracks, farther ties should appear to be narrower and closer together. Perspective correction ensures this accuracy.

Fogging

Fogging is exactly as it reads. It simulates haze and visibility characteristics. Fogging allows objects to emerge instead of just appearing.

Alpha Blending

This feature helps create accurate transparencies. It makes sure that the final image retains transparent objects' color and opacity. Fogging applies to the environment; alpha blending applies to objects.

Texture Shading

Unless using wire-frame objects, 3-D rendering requires some sort of shading. Numerous shading types exist. Flat shading is the simplest; it simply applies a solid color to the surface. Gouraud shading enhances realism by using color gradients. The final form is texture mapping. Texture mapping is the core process that applies textures to polygons, producing photo-realistic surfaces.

Z-Buffer

Z-Buffering helps remove unseen objects and surfaces. Because a scene only contains objects and surfaces visible from a given viewpoint, it can reduce the amount of unnecessary processing.

An endless variety of other features exists. Double buffering, bump mapping and others are a just a few of the more recent. Each card offers a different variety. Future engines continue to expand the feature list. While each new feature adds value, it's important to remember that software needs to grow to include these new features too.

It's also important to remember that vendors offer different processes to accomplish the same effect. The sophistication level varies according to the card's core engine, drivers and overall capabilities. Little is certain beyond the core polygon and texture concept, but most products tend to support only those features it can support well. Though certain features



benefit certain software more than others do, a card's value is truly the sum of all its characteristics.

Flight Simulators and 3-D

Most flight simulators are in 3-D infancy. Despite its obvious advantages, few of the most popular simulations stretch 3-D's limits. The most dramatic improvements come from the contrast to their historically lackluster performance and 2-D image quality. While the best may be yet to come, 3-D offers flight simulators immediate and tangible benefits.

Each software genre tends to exploit different 3-D features. Certain features benefit flight simulators more than others do. It's hard to predict what features will serve future software best. A wider variety offers more software latitude and provides some measure of investment protection. "More" may be "better." Without clearly defined standards and features, selecting an accelerator whose features favor flight simulation can be equally beneficial.

There is no default "best" 3-D product. Except for systems with the fastest CPUs, 3-D's largest benefit is performance. Selecting an accelerator that off-loads the most processing, perhaps at the expense of features, will tend to offer such users the best results. Users at the higher end of the CPU scale can focus more on features, using their fast CPUs to assist speed. Even without graphics, flight simulators are naturally resource intensive. Regardless of the core CPU, at some point, the payback curve will bend.

Effects-oriented features require far greater resources, and support through software emulation can impose significant performance penalties. Because of landscapes, mountains, rivers and other features, flight simulators tend to be texture-intensive. Making hardware texture effects a priority and pursuing the most texture memory can directly improve performance, yielding very impressive images. These features offer the greatest benefit when they are hardware-accelerated.

Fogging can provide some of the most realistic environmental effects. Given the nature of clouds and fog, the reasons are obvious. Descending through clouds and realistic poor visibility can add a whole new dimension to virtual flying. Fogging is complex. Its sophistication depends almost entirely upon the degree of hardware support. Cards that implement software support usually offer less impressive (yet still quite nice) fogging effects. Other transparency-related effects, like alpha blending, are far less important because few simulator situations involve looking through windows. Fogging is certainly one feature that deserves attention; the more it receives the better.

Obviously, numerous features remain. There are simply too many, going well beyond this fundamental perspective. Many simply do not apply to flight simulation. They are nice to have nonetheless, and offer a wider variety of features for other titles.

Summary

Now that some of the dust has settled, it's becoming possible to see the state of affairs. Three certainties have emerged.

3-D graphics offers better performance and realism

3-D graphics is a more-than-welcome addition to today's most popular flight simulators, offering better performance and realism than ever before. It offers more visual features and has allowed many users to improve performance without requiring a faster CPU.

Its novelty has confused some flight enthusiasts

Second, its novelty has confused many flight simulation enthusiasts. It brings a host of new terms, and evolving features lack clearly defined standards.

3-D video is an excellent flight simulator feature. The keys lie in knowing what to expect and having a solid practical understanding.

Frustration

Finally, many simulators have experienced some frustration. New software, newer hardware and evolving drivers have been major contributors, but the majority results from misplaced expectations.

Without understanding what 3-D offers and what it does not, entering the 3-D world can be a challenge. Despite its technological advances, 3-D graphics also represents something that is just plain different. Because much is artistic, some will like its features while others won't. Beauty is in the eye of the beholder. Furthermore, different enthusiasts, choosing different solutions, encounter vastly different results. However, most concerns arise from the unexpected. Despite the confusion, after fitting all the pieces into place, few would rush back to the slower and less sophisticated 2-D environment.

Perhaps the most important overall point remains. Neither blazing speed nor hardware support for every 3-D feature is necessary to realize a huge benefit. Also, for some people, slower 3-D engines supporting fewer effects may actually offer better overall performance and satisfaction than faster cards relying heavily on software support. Once again, it's a delicate balancing of a fixed resource pool. The best solution will be the one that best suits flight simulation products and a given user's performance, needs and budget requirements. 3-D video is an excellent flight simulator feature. The keys lie in knowing what to expect and having a solid practical understanding.

The Virtual Hanger

Readers Guide To 3D Technology

3-D Hardware For PC-based Flight Simulation

By Bruce Wilson

If you read the newsgroups on the Internet or belong to a flight-sim mailing list, you've heard a lot of talk about 3-D. Microsoft *Flight Simulator 98* (FS98) supports 3-D acceleration. Other civilian flight sims, like Looking Glass Technology's *Flight Unlimited II* and Laminar Research's *X-Plane*, also run with 3-D acceleration, along with almost every military flight sim available. New video cards show up every day claiming to be the fastest or the best. And like any new technology, 3-D has more than a few simmers scratching their heads over it all. Here we'll talk about what 3-D is and how you may best use it to enhance your flight sim experience.

APIs

Unfortunately, more than one group of engineers thought of this, and they each came up with a different way rendering 3-D images. These methods are called "APIs" (Application Programming Interfaces). Sims and games currently use four main APIs: Microsoft's *Direct3D*, Silicon Graphics's *OpenGL*, 3Dfx's *Glide* and Rendition's *Redline*. Chart 1 (on pages 15-16) lists each 3-D-accelerated flight sim, who makes it, the size of the downloadable demo, and which 3-D APIs the program supports.

Chart 2 (on pages 17-18) lists the consumer 3-D hardware chipsets available. I have listed the hardware as chipsets because, with few exceptions, all cards that use a particular chipset behave identically. See the text below to find some of the cards used by each chipset. Data is listed by the chipset name, the maker of the chipset (not the cards that use the chipset), whether the chipset supports 3-D acceleration in a window on the computer desktop, and the maximum resolution supported in FS98. The amount of texture memory each chipset uses is listed, and if that memory is shared with the frame buffer. Next, drivers support for the four most popular APIs are listed. The speed factor is the relative performance of each chipset in FS98, based on a Voodoo card in a Pentium II 300-MHz system, listed for Pentium II 300 MHz, Pentium 200 MMX, and Pentium 133 systems. Visit the FS98 Benchmarks site (<http://fsbench.bw.ml.org>) for full details and up-to-date information. The Image Factor is a subjective assessment of the visual impact of each chipset, and takes into account those 3-D effects that are not supported by the chipset (e.g., Matrox scores low because it does not support hardware fog/haze).

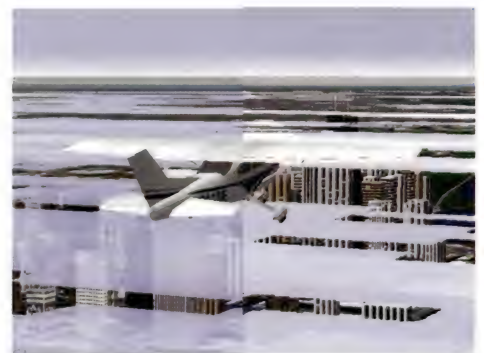
The Look of 3-D

3-D acceleration both speeds up programs and improves the image quality. Here are some screen shots from several 3-

D-accelerated flight sims on a 3Dfx Voodoo Rush card. The individual effects used in these screenshots are described below.



FS98, hardware-rendered on the left, software-rendered on the right.



FS98 clouds, rendered in hardware (left) and in software (right). This effect requires that cloud thickness be turned off.

3-D Hardware For PC-Based Flight Simulation

Civil Sims						
Game	Maker	Download Size, MB	Direct3D	Glide	OpenGL	Redline
Flight Simulator 98	Microsoft		X			
Flight Unlimited II	Eidos Interactive		X			
SGL Flight Simulator	Private Op'enGL port	1.8			X	
X-Plane 4.0	Laminar Research	8.8 (beta)			X	
Military Sims:						
Game	Maker	Download Size, MB	Direct3D	Glide	OpenGL	Redline
Air Warrior III	Kesami	22.4	X			
Apache/Havoc	Empire Interactive		X			
Apache-Longbow	Digital Integration			X		
Comanche Gold	Novalogic		X			
Comanche/Hokum	Empire Interactive		X			
Combat Flight Simulator	Microsoft		X			
Confirmed Kill	Eidos Interactive		X	X		X
EF2000	Digital Image Design			X		X
F/A-18 Korea	Graphics Simulations	10		X		
F-15	Jane's Combat Simulations			X		
F-16 Fighting Falcon	Digital Integration			X		
F-22 Air Dominance Fighter	Digital Image Design		X	X		
F-22 Raptor	Novalogic	10	X			
F-22 Total Air War	Digital Image Design		X			
Falcon 4.0	Microprose	44		X		
Fighter Dual II	Phillips Media			?		
Flying Corps Gold	Empire Interactive		X			
Front Line Fighters	Digital Integration			X		
Hind	Digital Integration			X		
iF/A-18E CSF	Interactive Magic Labs		X			

Military Sims (continued):						
Game	Maker	Download Size, MB	Direct3D	Glide	OpenGL	Redline
iF-16	Interactive Magic Labs	13		X		
iF-22	Interactive Magic Labs		X			
Incoming	Rage	3.9	X	X		
Jet Fighter III	Mission Studios	12.2		X		
Joint Strike Fighter	Eidos Interactive	12.7	X			
Longbow II	Jane's Combat Simulations	29.4	X	X		
MiG Alley	Empire Interactive		X			
Plane Crazy	Inner Workings	39.3	X			
Sabre Ace	Virgin Interactive	50	X			
Silent Thunder A-10 Tank Killer II	Sierra	3.7				X
Survival	Dragonfly Reality	2.3	X			
Tactical Aero Squadron	Pro-Line Simulations			X		
Team Apache	Eidos Interactive		X			
Warbirds 3D	Interactive Creations			X		
Warthog Prevails	MetaVR	3.6	X			



A collection of screenshots from some of the best-looking 3-D-accelerated games. Top, *Incoming*, with some of the best explosion effects yet seen in any game. Bottom, a *Cessna 182S* landing ORD 27R at dusk, in the fog, where runway lights are the most beautiful sight in the world.

Bilinear filtering, or image smoothing

This technique smoothes the “blocky” appearance of textures when viewed close-up. Textures in flight sims typically look best when viewed from about 5,000 feet. This means that when viewed from ground level, all we see are the individual pixels that make up the texture. Filtering, or smoothing, is used to blend neighboring pixels so that they don’t have a distinct edge; instead they blur into each other. Simmers generally favor using image smoothing but there are drawbacks. Some images will be smoothed that shouldn’t be smoothed, like aircraft textures or the runway at Meigs in FS98. Smoothing can also affect the perception of speed when flying close to the ground. FS98 can also do software image smoothing, but it is costly to the frame rate and doesn’t look as good as hardware filtering.



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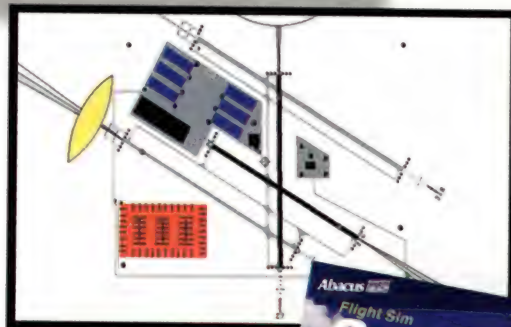
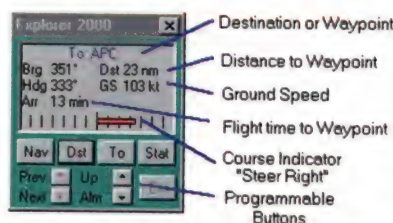
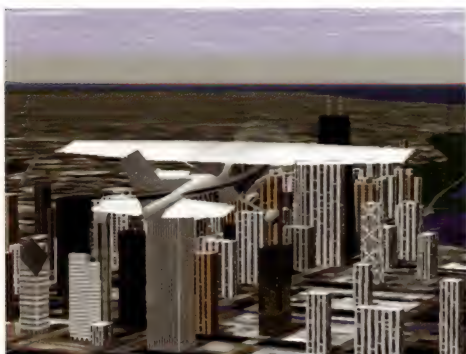
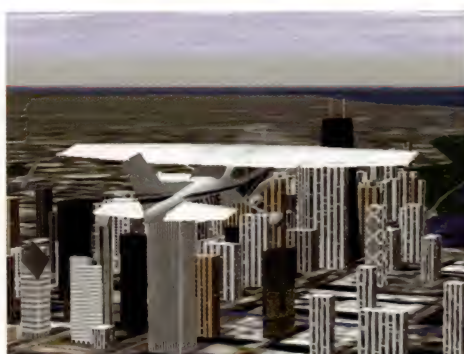


Chart 2 lists the consumer 3-D hardware chipsets available.

Chipset	Maker	Windowed 3D?	Max. Resolution pixels	Texture mem. MB	D3D?	Glid
i740	Intel	Yes	1600x1200 (8 MB)	4-8 (AGP) 12-24(PCI)	Yes	No
MGA	Matrox	Yes	1600x1200 (8 MB)	2-8 (shared)	Yes	No
Permedia2	3Dlabs	Yes	1600x1200 (8 MB)	4-8 (shared)	Yes	No
PowerVR/PCX2	NEC	Yes	2D-card res.	4	Yes	No
Rage II	ATI	Yes	800x600	4 (shared)	Yes	No
Rage Pro	ATI	Yes	1600x1200 (8 MB)	4-8 (shared)	Yes	No
Riva128	nVidia	Yes	1152x864	System RAM	Yes	No
Vérité 1000	Rendition	Yes	800x600	4 (shared)	Yes	No
Vérité 2100	Rendition	Yes	1024x786	4 (shared)	Yes	No
Vérité 2200	Rendition	Yes	1600x1200	4-8 (shared)	Yes	No
ViRGE./DX, /GX	S3	Yes	1024x786 (4 MB)	2-4 (shared)	Yes	No
Voodoo	3Dfx	No	800x600	2	Yes	Ye
Voodoo Rush	3Dfx	Yes	1152x864	2-4	Yes	Ye
Voodoo2	3Dfx	No	1024x786	4-8	Yes	Ye



FS98 3-D shot, with hardware image filtering on the left, without image filtering on the right.



16-bit (left) vs 8-bit textures (right).



A rocket launch in Longbow 2. Notice the lens flare of the rocket motor.

Bitmap or texture

A picture of the surface of a plane or the ground is usually a bitmap (.BMP) file. Textures are rendered over polygons to create the 3-D world. It is possible to use 8-bit textures instead of the usual 16-bit textures, with some loss of colors in the image, especially at airports, where the green grass turns to gray concrete. Using 8-bit textures uses only half the texture memory, however, and is an advantage in low-memory cards at high resolution and dense scenery.

Lens flare

One of the tricks that make a rendered image look more cinematic, lens flare is seen as either rings of light (that might come from reflections in a camera lens photographing the scene) or as a star-shaped glare around bright lights or flames. This effect is typically used in military flight sims.

MIP mapping

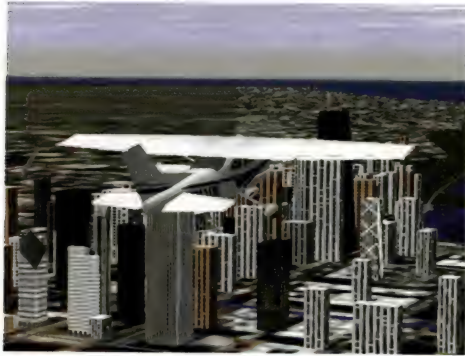
This technique speeds rendering of "distant" textures and removes "speckle" from distant textures. Multiple textures are generated from a single texture in order to display that texture in a smaller form. For example, if we had a 128x128-pixel texture, the API would calculate versions of the texture at 64x64, 32x32, 16x16, 8x8, 4x4, 2x2 and even 1x1 pixels. Then when the texture is displayed at a "distance," where it would appear smaller, the program already has a smaller version to use. When our 128x128 texture is displayed at, say the 32x32 size, without MIP mapping the program has to figure out which pixel of the 128x128 texture corresponds to a pixel in the 32x32 section on the screen. The program doesn't choose the same pixel every frame,



3-D Hardware For PC-Based Flight Simulation

OpenGL?	Red-line?	Speed Factor-P11/300	Speed P200	Speed P133	Image Factor
Full	No				1.1
No	No	0.7	0.4	0.3	0.4
Full	No	1.3 (AGP)			0.9
Partial	No	0.4	0.3	0.2	0.7
No	No	0.4	0.3	0.2	0.8
?	No	0.7	0.4		0.9
Full	No	1.3 (AGP)	0.5	0.4	0.9
Partial	Yes	0.7	0.4	0.4	1.1
Partial	Yes	0.9	0.6	0.4	1.1
Partial	Yes	1.0	0.6	0.4	1.1
No	No	0.4	0.3	0.2	0.6
Partial	No	1.0	0.6	0.3	1.0
Partial	No	0.9	0.5	0.3	1.0
Partial	No	1.0	0.7		1.1

so a single screen pixel will change color with every frame, causing a shimmer or speckle. But if we use the 32x32 texture, the pixels will all match, and the image will look smooth rather than grainy.



FS98 MIP-mapping on (left), and off (right).

Currently available 3-D video hardware

Here is a brief list of the 3-D video cards you will find when you start shopping for a new accelerator. My description of these cards is based on what I gleaned from talking with users of these cards. While I have tried to be unbiased, you will notice that many users have very different opinions. In the end it is only your opinion that counts. Use charts 1 and 2 to select the card that supports the greatest number of games you like to play.

Before we discuss the particulars of each 3-D chipset, we should mention how 3-D accelerators work in your system. There are three forms of 3-D hardware: 2-D/3-D cards, 3-D-only add-on cards and 2-D/3-D add-on cards.

The 2-D/3-D cards support both view modes. Most 3-D accelerators are 2-D/3-D cards, using such chipsets as the Riva128, ViRGE, Rage Pro, the Vêrité series and Voodoo Rush. These run 3-D applications in a window or full screen. All 2-D/3-D cards are available for the PCI bus, and some cards will work in the newer AGP slot.

3-D-only standalone cards, all based on the Voodoo or Voodoo² chipsets, occupy PCI slots. They connect to your 2-D card through a short video cable, and your monitor plugs into the Voodoo card. When the 2-D card is active, the signal travels to the 3-D card and is passed through to the monitor. When the 3-D card becomes active (when you switch to full-screen mode in FS98), the Voodoo card cuts off the 2-D passthrough and sends its own signal to the monitor. Because of this you get 3-D only in full-screen mode, not in a window. These cards do not need any IRQ or DMA resources assigned to them, just a PCI slot.

2-D/3-D add-ons (all based on PowerVR chips) occupy PCI slots, but do not connect to anything else. They use the memory on the 2-D card to operate. When the 3-D card is active, it sends the processed 3-D image to the 2-D card over the PCI bus.

This means you should have a good 2-D card with at least four MB of memory. These cards run 3-D in a window or full screen.

3Dfx Voodoo²

The Voodoo² is the most recent chipset from 3Dfx. It is a 3-D-only add-on card, and it is very fast under Glide and the partial OpenGL miniport, but its performance under Direct3D is equal to other available cards. This may change as the drivers are tweaked for performance. This chipset consists of four chips: one triangle engine/pixel chip, two texture engines, and the display/RAMDAC chip. The Voodoo² has the unique ability to run in a special two-board mode called "SLI" (Scan-Line Interface). In SLI mode you can put two Voodoo² boards in your system, and each board will draw every other line. This means (1) it can go twice as fast as a single board (but users of FS98 will probably not see this advantage), and (2) it can use the combined frame buffer of both cards to run FS98 at 1600x1200 resolution. The FS98 Benchmark database does not have many entries for this chipset, but it looks to be about as fast as the Voodoo. Prices for the eight-MB cards are around \$200, and the 12-MB boards sell for between \$220 and \$300. Available now, but in high demand, you may have to shop around and pay top dollar for this card.

These are a few of the cards that use the Voodoo² chipset: Anubis Typhoon 3D Max II, Biostar Venus 3D II, California Graphics 3D Wizard, Canopus Pure3D II, Creative 3D Blaster Voodoo², Diamond Monster 3D II, Guillemot MAXI Gamer 3D², Jazz Multimedia Renegade 3D, Miro HISCORE², Orchid Righteous 3D II, Quantum 3D Obsidian II series, STB Blackmagic 3D.

3Dfx Voodoo Graphics

The Voodoo Graphics chipset, or "Voodoo" for short, was the 3-D accelerator for 1996 and 1997. It wasn't until early 1998 that another 3-D accelerator (the Riva128) beat it in raw 3-D performance. This is a 3-D-only add-on card, and thus it runs only in the full-screen mode. Full-screen only is considered a disadvantage by most FS98 users because many FS add-ons use a separate window. All other sims run best in full-screen, obviating the disadvantage. It is good to get the latest drivers for this card for best performance. This card may also be overclocked for better performance (for more information, visit either www.op3dfx.com or www.voodooextreme.com).

These cards use the Voodoo Graphics chipset: A-Trend Helios 3D, Canopus Pure 3D, Colormaster Voodoomania, Deltron Flash 3D, Diamond Monster 3D, Guillemot MAXI Gamer 3Dfx, Miro HISCORE 3Dfx, Orchid Righteous 3D, Quantum 3D Obsidian series and Skywell Magic 3D.

3Dfx Voodoo Rush

The Voodoo Rush is 3Dfx's attempt to get Voodoo quality and speed in a 2-D/3-D card. While the Rush is slightly slower than the Voodoo, it performs well in a window. The Rush is actually three chips: one Texture effects unit, one pixel effects unit and the Alliance AT3D chip that handles all the 2-D functions. In FS98 this chipset has the disadvantage of being very susceptible to sound stutter. Many driver combinations are available for this chipset, and improvements are still being made with approximately monthly releases. They come in six-MB (four MB frame buffer, two MB texture memory) and eight MB (four/four) versions.

Cards that use the Voodoo Rush chipset include: A-trend 3D Voodoo Rush, Apollo 3Dfx, California Graphics Emotion 3D, Deltron Flash AT3D Rush, DFI WG-8200 / 3DX, Hercules Stingray 128/3D, Intergraph Intense 3D, Jazz Multimedia Adrenaline Rush, Skywell Magic 3D Rush, Viewtop Rush 3D.

3Dlabs Permedia2

A chip renown for its OpenGL drivers, the Permedia2 works to keep up with other similarly priced cards when running games. It runs best in FS98 with MIP mapping disabled. \$160 for an eight-MB card is as cheap as I've seen it.

These cards use the Permedia2 chip: AccelGraphics Accelstar II, Creative Graphics Blaster Exxtreme, Deltron RV Power 3DGL-II, Diamond FireGL 1000 Pro, Elsa Winner 2000/Office, Elsa Gloria Synergy, Elsa Gloria XXL, Hercules Dynamite 3D/GL, LeadTek WinFast 3D L2300, STB Twister 240 and STB Twister 280.

ATi Rage II

This older card has trouble keeping up with more recently released accelerators. If your Pentium system came with one of these, look to upgrade.

ATi Rage Pro

Another card often found in complete systems, this isn't as fast as the Riva or Vérité 2x00 systems.

Ati's Xpert@Work and Xpert@Play use the Rage Pro chip.

Intel i740

This chip is aimed at the mid-level 3-D market, between the gaming and the budget markets. You'll see it built into lots of Pentium II boards. It will sell for less than the Riva128 chips and will likely be slightly slower. It does, however, support all the features of the Voodoo and Riva128 chipsets. Like the Riva, this chip runs best using AGP,

with all textures stored in system RAM. It currently sells as a four MB board for \$190 and eight MB for \$230, in PCI and AGP versions.

Cards that use the i740 chip include: ASUS (motherboard mounted), Diamond Stealth II G460, Real 3D Starfighter and STB Lightspeed 740.

Matrox MGA

Once the king of 2-D performance, these chips have some 3-D features but lack several important ones, like fog/haze and MIP mapping, making them effectively a 2½-D chip.

All Matrox boards (Millennium, Millennium II and Mystique) use the MGA chip.

NEC PowerVR PCX2

The NEC PowerVR PCX2 chip is a 3-D-only chip. But unlike the Voodoo 3-D-only chipset, this chip depends on the system 2-D card: it uses the memory of the 2-D card for the frame buffer. So a four MB m3-D card next to an eight MB Millennium card would have four MB of texture memory and eight MB available for the frame buffer. It will render 3-D in a window.

Cards that use the PowerVR chip include: Matrox m3D, VideoLogic 3Dx, VideoLogic 5D (2D/3D), VideoLogic 5D Sonic (2D/3D).

nVidia Riva128

This was the first (and so far only) chip to beat the Voodoo. It is a very impressive chip and relatively inexpensive. The memory on the card is used exclusively for frame buffer; it has no texture memory. Instead it uses the computer RAM for texture storage, and retrieves them every time it needs them. For this reason it runs best (by about 30%) in an AGP configuration. The best frame rate reported using the FS98 Benchmarks is a four MB Riva128 in the AGP slot of a Pentium II 300 MHz. This chip runs best in fast systems (above 200 MHz). It sells in a four MB version for about \$160 (PCI) and \$170 (AGP).



3-D Hardware For PC-Based Flight Simulation

These cards use the Riva128 chip: ASUS 3D Explorer, Canopus Total 3D 128V, Diamond Viper330, E4 CoolView 3D, Elsa Erazor Victory, MiroMagic Premium, STB Velocity 128.

Rendition Vérité 1000

The Vérité 1000 is the first chip with triangle setup in hardware. It is a little slow in today's market.

These cards are based on the V1000 chip: Creative Blaster 3D, Sierra Screamin' 3D, Intergraph Reactor.

Rendition Vérité 2100

This chip impressed everyone because it was supposed to be the runt kid brother of the V2200, but it wasn't runty. It has good hardware triangle setup, so this chipset runs as well on slower systems as it does on Pentium IIs. The Vérité 2100 is good for Pentium 133s or slower machines. It sells for about \$100 in the four MB form.

The Diamond Stealth S220 is based on the V2100 chip.

Rendition Vérité 2200

This chip was released late, and the V2100 got all the press, but it's faster than the V2100. The eight MB cards sell for about \$200.

Cards based on the V2200 chip include: DSsystems Gladiator, Genoa V-raptor 3D, Hercules Thriller 3D, Jazz Multimedia Outlaw 3D.

S3 ViRGE/DX/GX

The ViRGE chip was the first 3-D hardware chip on the consumer market. It was also the slowest. The images from this chip look good, but because the rendering engine is slower than the other chipsets, it is difficult to recommend this for any 3-D application. Unfortunately, these cards are very inexpensive, and many people buy them from ignorance. Cards based on the Vérité 2100 are a much better value. It has good 2-D performance, however. The ViRGE/DX

and /GX are available now, but the performance of these new chips isn't substantially better than the original ViRGE.

Cards based on the ViRGE chip: Diamond Stealth 3D 2000/3000 and many others.

Hints and Tips

Here is a random collection of some of the most common hints and tips that I have collected from the Internet newsgroups and mailing lists. I hope you find them worthwhile.

Make sure you are in 3-D mode

There are three settings in FS98 that must be set correctly to run in 3-D mode; if any one of them is set wrong, you will run in 2-D only. All these settings are made in the Options\Preferences...\Display\Display Options...\Hardware Acceleration menu. First, click on the Hardware Acceleration checkbox. Next, select the Direct3D or the 3Dfx driver. With some cards you may see only a Primary Display Driver. Third, select the video display mode you wish, but make sure to select a 16-bit color mode (e.g. 800x600x16). If you have a 2-D/3-D card and want to run 3-D in a window, you should use a 16-bit (32 or 64 thousand color) desktop. All other flight sims have a video options screen where you may select a 3-D mode and are designed to run full-screen only. If you are going to buy a 3-D-accelerated program, make sure it is compatible with your video card: only 3Dfx cards will run anything programmed in Glide. All 3-D-accelerated video cards will run a Direct3D program.

Test your frame rate

To see the current frame rate in FS98, press **(Shift)+[Z]** twice. By observing the frame rate with various settings, you can optimize your system for highest frame rate, for optimally realistic images, or for a setting in between that best suits you. For *Flight Unlimited II*, press **(Ctrl)+[F]** to display the

frame rate. Consult the manual or the on-line help that came with other programs to learn how to display their frame rates.

See-through clouds in FS98

Go to Options | Preferences... | Display | Display Options... | Scenery and deselect "Cloud thickness effects."

Panel readability in FS98

Go to Options | Preferences... | Display | Display Options... and set Image Quality to high and Speed to slow. If you still can't read the digits, switch to a higher resolution mode.

Get the latest video card drivers

This applies to all cards, running all programs. For example, the drivers that come with a Voodoo card will give you very large runway lights. This is fixed with updated drivers from the card manufacturer. The latest drivers for the Riva128 chipset improved performance another 30%, even though the card has been out a year. Check for new drivers monthly to keep up.

FS98 multiplayer chat in full-screen

One of the new features of FS98 is multiplayer flying. During flight it's necessary to talk with the other pilots, and FS98 uses a chat window for this communication. Unfortunately, this window is invisible when using a full-screen view necessary for 3-D rendering with a Voodoo card. Here is how to use multiplayer chat in full-screen mode: Initialize a multiplayer session in 2-D mode, with the chat box open. Next type **(Alt)+[Enter]** to switch to full-screen mode, then type **(Ctrl)+[Enter]** to close the chat window. This causes chat messages to scroll across your screen. To type a message for others:

1. Type the **Enter** key
2. Type your message
3. Type the **Enter** key to transmit your message
4. Type **Ctrl+Enter** to re-enable message scrolling

Repeat these steps every time you want to send a message. Note that you lose the ability to scroll back to see old messages. Running FS98 in a 3-D window is preferable.

Gray buildings and aircraft in FS983

If some buildings or aircraft are gray rather than textured, you have probably run out to texture memory. This sometimes happens with dense scenery on video cards with four MB memory. It is cured either by lowering the scenery complexity or by using eight-bit textures. If you use eight-bit textures you may see some odd things, like the grass around airports turning to concrete and buildings looking a little fuzzy.

Improve your frame rate

This applies to all 3-D-accelerated programs. Some 3-D effects are free, and some are expensive. What I mean by "free" is that the frame rate is not affected when the effect is enabled, and enabling expensive effects will lower the frame rate. These effects are image smoothing (bilinear filtering), MIP mapping fog and haze, textured clouds, lens flare, explosion effects, etc. Unfortunately, I cannot tell you which effects come completely free because all cards are different. You will need to experiment to find the best balance between the look of the sim and the frame rate. Personally, I need at least 20 frames per second (fps) to control an aircraft smoothly, so I turn off all effects, then start adding them one by one until the frame rate drops to 20.

Upcoming 3-D Hardware

What does the future hold? For readers who aren't ready to buy a 3-D accelerator right now but want one in the next year or so, there is very good news. The next crop of 3-D hardware accelerators are very exciting because of the amazing features and performance we can expect, and because they are expected to sell for no more than current 3-D cards. Here is a run-down of the announced hardware. Keep in mind that these chips do not exist in final form, and performance data is not based on independent testing. Most of the data listed below is based on press releases and on demonstrations of very early versions of the chips, and is just as likely to change as not.

nVidia Riva128ZX

This update of the Riva128 sports 30% faster 2-D acceleration and an eight MB frame buffer. 3-D performance will not be different from the Riva128. It also will have a faster RAMDAC, so it will support higher monitor refresh rates with slightly better color stability.

nVidia Riva TnT

The TnT stands for "Twin Texel Architecture," which, like the Voodoo², allows two textures to be rendered in one pass. nVidia hope this 2-D/3-D chip will be the ultimate Voodoo² killer. To begin, it sports seven million transistors, as many as a Pentium II chip! nVidia says the TnT will do 2-D faster than the Riva128ZX. It will render 3-D in 24-bit color, instead of the 16-bit color supported by current consumer 3-D hardware, which gives a better picture. nVidia claims that the TnT will have a fill rate of 250 million pixels per second, unexcelled by anything on the market, and a triangle rate of eight million triangles per second, both much higher than even the Voodoo² can do in SLI mode. This chip is due September 1998,

but because it will be a technological challenge, expect that date to slip. Boards using the Riva TnT will sell for around \$150 to \$200 for eight and 16 MB cards. Features include trilinear filtering, anisotropic filtering, triangle setup, supports strips & fans, 24-bit Z-buffer, edge anti-aliasing, 32-bit rendering, bump mapping, environment mapping, stencil buffer, 250 MP/s, 6-8 MT/s and 16 MB RAM.

NEC PowerVR Next Generation

The PVRNG, or the PVRSG ("second generation"), has specifications as impressive as the TnT. This is the first chip to do full geometry and texture setup in hardware, offloading a great deal of work from the CPU. It also has a texture compression feature that will let a card with four MB RAM store about 24 MB of textures. NEC says this chip will do 120 million pixels per second. This is about half of what is claimed for the Riva TnT, but there is one advantage to the PVRNG: it already exists. It has been demonstrated at trade shows to very enthusiastic fans of the Voodoo² and won them over. It may ship as early as late May or June, for about \$150 (eight MB) to \$200 (16 MB). Like the PowerVR/PCX2, it is a 3-D only add-on card that uses your current 2-D card for frame buffer storage. It will also sell in a 2-D/3-D combination card, like the Voodoo Rush is sold. Features include Trilinear filtering, anisotropic filtering, full triangle setup with culling, supports strips & fans, 32-bit Z-buffer (no memory required), anti-aliasing (by downsampling), 32-bit rendering, bump-mapping, environment mapping, volumetric lighting effects, up to 8:1 texture compression, 120 MP/s, 1.2 MT/s, and supports up to 32 MB RAM.



3Dfx Banshee

Not much is known about the Banshee. 3Dfx has not said anything about it other than it is a 2-D/3-D single chip and should have 3-D performance similar to the Voodoo². Expect a late 1998 release.

Matrox MGA-G100 and MGA-G200

These 2-D/3-D chipsets will be slightly slower than the Voodoo² in 3-D (the G100 will be slower and cheaper than the G200), but they will have a

better image. They render 32-bit color in 3-D mode and will have what we have come to expect of Matrox: excellent 2-D performance. It is due in June for \$100 to \$200 ESP, with eight to 16 MB memory. With 32-bit rendering, it will need a lot of RAM for the frame buffer, eight MB minimum, probably 16 MB to run comfortably. The G200 features trilinear filtering, triangle setup with culling, supports strips & fans, 32-bit Z-buffer, anti-aliasing, 32-bit rendering, environment mapping, 100 MP/s, 1.5 MT/s, and up to 16 MB RAM.

Upcoming 3-D Features

Setup Engine

More advanced 3-D hardware will have a setup engine. Before rendering, all polygons must be converted from the 3-D-world coordinates to 2-D screen coordinates. A hardware setup engine takes additional load off the CPU, which generally results in higher frame rates in FS98, especially in slower Pentium computers. Only the Rendition Vérité chips and the Voodoo² currently have hardware triangle setup. Triangle setup comprises about 15% of the entire geometry and texture setup process.

Strips & Fans

This technique abbreviates the definition of a polygon to speed rendering. Not currently supported by any API, it will be a part of the next release of Direct3D 6.0 and Glide 3.0.

Trilinear filtering

A better-quality version of bilinear filtering currently supported by Voodoo² boards running Direct3D programs.

Volumetric Effects

This method defines lights more realistically, like a street lamp in the fog or the glow of your landing lights just before you break out of the clouds on a nighttime approach. Look for this in future hardware and software.

Z-Buffer

A third buffer (or a fourth if triple buffering is enabled) stores depth data to help hardware sort out which textures are visible and which are hidden. FS98, like most Direct3D programs, does not support a Z-buffer. OpenGL and Glide programs rely on the Z-buffer, however, with a drastic performance penalty if not supported in hardware.

Configure your sound in FS98

"What's that?" you say? What has sound to do with 3-D video? A great deal, as it turns out. 3-D video places a large load on the computer CPU and the data bus. Anything you do to remove load from the data bus helps the frame rate, and configuring the sound can free a lot of the data bus. If you add these

lines to the FLTSIM98.CFG file (in your FS98 directory), the data requirements for sound will be only 12% of the default settings:

```
[sound]
SamplesPerSec=11025
Channels=1
BitsPerSample=8
```

The default values are "22050," "2," and "16," respectively, and any line you do not include in the FLTSIM98.CFG file will use the default setting. Each setting halves the data load from the sound system. Some of these settings can be added with no sound degradation. For example, if you are using a single speaker or if you have two speakers placed close together, you will not notice that mono sound (`channels=1`) is any different than stereo (`channels=2`), so you might as well use the mono sound setting. The other two settings each lower the fidelity of the sound system. If you experience sound stuttering, you may want to try the lower fidelity settings.

You can test the influence the sound system has on video performance by selecting a situation with no motion (sitting on a runway looking toward a city) and observing the frame rate (**Shift+Z**) until it settles down. Then press **Q** to turn the sound off and see if the frame rate increases. If it increases by one or two FPS, you might want to change one of the settings above. These settings are also the method for helping to cure any sound stuttering you may hear in FS98.

Using non-rectangular panels sometimes eliminates sound stutter. Sound stutter in FS98 is mostly heard with ViRGE and Rush chipsets, and I'm afraid to say there isn't a single cure for this. Just use a combination of the suggestions above and hope for the best. Other flight sims might also benefit from lowering the fidelity of the sound, but in my experience no other flight sim exhibits sound stutter.

Video pausing

There have been many long-running discussions about video pausing in the newsgroups, and this is somewhat controversial. It seems there are three types of pausing in FS98. Whenever new scenery is needed for your flight, FS98 will access the CD. While this happens, the program pauses. This type of pausing coincides with CD access and is eliminated by installing more scenery on your hard drive, if you have the room.

A second type of pausing looks the same as scenery-access pausing, but comes from other programs running in the background.

Virus scanners, Internet access and system utilities (like Fast Find and ODBC) may use the CPU for a moment. Removing or deactivating these utilities will eliminate these pauses. Both these causes will afflict both 2-D and 3-D modes.

The third kind of pause is seen only in 3-D mode, and I'm afraid to report there is no cure. This pause is seen mostly over cities and gets worse with scenery density and with add-on scenery. While many fixes have been proposed for 3-D pausing, none work on all systems. It seems that faster systems are less susceptible to pausing. It will be up to Microsoft to eliminate it. You can minimize pausing by using normal to sparse scenery and by using the suggestions in the sound stuttering paragraph above.

The FS98 3-D-settings panic button

Sometimes users of FS98 find that they have done something very bad with the 3-D settings, so that they are met with a black screen when FS98 is started. If you need to switch back into 2-D mode but cannot run FS98 properly, there is a way. In the FLTSIM98.CFG file in your flight sim directory, you can add the line "Direct3D=0" under the [hardware] section. Then in FS98 you can alter the offending setting.

Conclusion

I think flight sims are at an important point right now, when technology can put on your desktop the same power that the best simulators had less than a decade ago. This is fast-changing technology, and it's up to us simmers to embrace 3-D technology. I hope that this 3-D primer and guide will help you get a little closer to that ultimate goal: to recreate the sensation of flight. I can't wait to see what the next decade will bring!

Full Throttle Website

Don't forget to visit the *Full Throttle* website (<http://www.ftmagazine.com>).



Check out the new article by the Managing Editor of *Full Throttle* magazine, Tim Dickens, on panel design. The article explains the tools required to build your own panels and steps you through how to assemble them and get them working in Microsoft's *Flight Simulator 98*.

While on your visit, be sure to check out the back issues and the other information and files available on the *Full Throttle* Web site.

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Resources

Chipset manufacturers:

www.3dfx.com	www.3dlabs.com	www.NEC.com
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3-D resources:

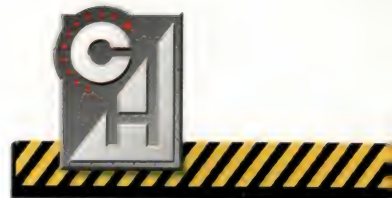
www.op3dfx.com	www.voodooextreme.com
www.rivazone.com	www.3dgaming.com
www.dimension3d.com	www.3dgen.com
www.fastgraphics.com	

Flight-sim related sites with 3-D content:

www.AVSIM.com	www.simflight.com
--	--

The author's FS98 Benchmark and 3-D Hardware site: fsbench.bw.ml.org. For more information, contact the author at BruceWilson@Earthling.net.





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Design Forum

Painting Scenery Textures for MS Flight Simulator

by Eric Mitchell

Introduction

Microsoft *Flight Simulator* comes complete with dozens of textures representing many different types of terrain. Even so, many areas of the world cannot be represented realistically with these default textures. Sooner or later the avid scenery designer will encounter a design challenge that requires the creation of a new texture. Though there are many different ways to make new textures, this article describes one particular approach in detail.

Texture Applications

There are two ways to incorporate textures into scenery. One is to access the texture as part of the standard tile system, also called "synthetic scenery." The other is to create a flat (planar) polygon and map the texture onto the ground (known as "procedural" or "section nine" scenery). I won't address the scenery compiler coding aspects of these two methods, but it is important to consider the main differences when planning to create a new texture.

First, synthetic scenery tiles are roughly two miles long on a side (the size varies according to latitude), so this is not the best choice for covering a very small area. Even more importantly, each synthetic tile must be assigned a unique hexadecimal name combined with the word "seed," for example, SEED97.R8, and for that reason these are often called "seed" textures. To be accessible to *Flight Simulator*, all seed textures must be placed in the main FS *Texture directory. Since only a finite number of these hexadecimal values is available, care must be taken to avoid conflicts with seed textures already assigned by other scenery designers.

Although there is no "scenery authority" to regulate who may assign specific seed values, it is in everyone's interest to use them sparingly and appropriately and not overlap seed assignments. With dozens of seed assignments available, there is plenty of scope to provide the scenery design community with a wide variety of useful seed textures, as long as designers keep this basic idea in mind. In the interest of making the best use of the available seed texture assignments, designers should try to ensure that they use synthetic seed textures only for generic terrain that can be used by other scenery designers. Using them to create small, one-of-a-kind scenery areas is wasteful. If you want to see what seed textures are available already and which assignments are still open, Chris Baker maintains a comprehensive database of *Flight Simulator* texture files of all types.

This may be viewed on the Internet at www.avsim.com/mike/textures/pages/dbseed.htm.

Using custom textures in procedural scenery has its drawbacks as well, such as reductions in frame rates when multiple textures are overlaid. However, it offers much greater flexibility in that it can be used for different-sized textured areas as well as for the construction of three-dimensional textured objects.

Tools for Painting

Almost any commercial or shareware paint program can be used to create scenery textures. The main requirements are that it allows 256-color image editing and can be set to use the Microsoft *Flight Simulator* color palette. I have been using Adobe *PhotoShop 4.0* and the registered version of NeoSoft's *NeoPaint*. JASC's *Paint Shop Pro* is also very popular, especially because a free evaluation version can be downloaded from their Web site at www.jasc.com.

Freeware and shareware tools for creating textures are mostly concerned with conversion to/from the .R8 texture format that Microsoft uses, as well as viewing, making minor edits or adding special effects. Probably the most useful is *R8worx* by Roland Weigelt. It is a superb DOS-based texture-editing program that allows importing and exporting textures in .BMP format. It also includes very useful special effects, including

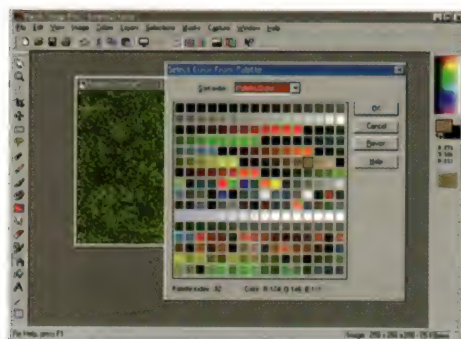


an excellent pseudo-3-D texturing algorithm. If you're going to make a lot of textures, this utility is indispensable. The shareware utility *R8paint* by Norm Campbell runs in Windows, but does not have nearly as many features as *R8worx*. It is useful as a quick texture viewer in Windows, though.

The FS Color Palette

An understanding of the FS palette is essential for creating realistic scenery textures. The palette file itself resides in the main FS Texture directory and has remained the same since FS 5.1. In fact, the file for FS98 is still called "FS5.PAL." Other palette options are available for different sceneries, especially those created from aerial photos (for example, the special palette for the Meigs Field area at Chicago and the palette for BAO's *Europe I* scenery). For the purposes of this article, I'll be describing only the basic FS5.PAL file, but the principles remain the same, and all *Flight Simulator* palette files share common features. All of them consist of 256 colors, and the first 128 colors (numbered 0 to 127) are common to all palettes.

When you display a texture in *R8paint*, *R8worx* or *Paint Shop Pro* and view the palette, you will quickly see that this first half of the palette is arranged in several color ranges.



The Flight Simulator palette in Paint Shop Pro

It starts with 32 shades of gray between black and white. Then various ranges of red, green, blue, orange, yellow, tan and so on up to color 115. These are the main scenery colors and are also used for all external aircraft textures, which is why they **must** be common to all palettes or *Flight Shop* aircraft would not appear correctly.

The next colors in this part of the palette (numbered 116 to 127) act somewhat differently from the rest in that they don't darken at night. These are the colors that are used directly in textures for night lighting effects. For example, Microsoft has used some of these in certain textures to give the appearance of ground lights at night. However, because of the way the textures are displayed, they tend to flicker on and off in a very distracting way. Most designers prefer to use these colors in procedural scenery as discrete dots to represent individual lights.

Colors 128 to 159 are only used for instrument panels and not for scenery textures. The colors in the 160 to 191 range are used for the sky and cloud textures.

Colors 192 to 255 are usable in scenery textures, but one must remember that the color values stored in these registers vary from palette to palette. If you are creating a seed texture that is meant to be used with a variety of scenery, you should avoid using these colors because they may display unpredictably when modified palettes are specified in the .BGL file. If the texture you are creating is intended only to be used within a specific scenery, then it is possible to use this range of colors.

Save the FS palette

Whether you are modifying an existing texture or creating a new one, you will definitely want to have the *Flight Simulator* palette available in your paint program. This is especially true when working with programs that require more than 256 colors to enable various special effects.

The first step is to obtain a screen shot of the simulator's default scenery during daylight conditions. Remember that the Meigs scenery, BAO's Europe scenery, the photo-realistic add-on areas and some third-party scenery use modified palettes, so if you want the normal default palette, move to another airport in the default scenery, perhaps Seattle-Tacoma, for example.

In *Flight Simulator 5.1* you can use the **Flight Photograph** option in the **Views** menu. The screen image will be saved in 256-color .PCX format in your flight simulator directory. From there it can be loaded into the graphics program of your choice. In FS95

or FS98, which run in Windows 95, first switch the display to 256-color mode, start *Flight Simulator* and set daylight conditions. Press the [Print Screen] key on your keyboard. This will capture the screen to the Windows clipboard. Load the graphics program of your choice and locate the Paste function, which is normally found in the **Edit** menu of most paint programs. Make sure that you save the image in a format that preserves the palette values and positions. I recommend .PCX or .BMP formats for this; avoid .JPG format. Give the image a name like FSPALETTE.PCX, so you have it available if you need to recreate the base palette later.

With the screen image displayed and selected in your paint program, you now need to access the Save Palette option. Here's how to do it in three of the most popular painting programs (others will be similar):

- ➔ In *NeoPaint*, open the **File** menu and select **Edit Palette...** In the Palette Editor, open the **File** menu and select **Save...** Give your palette a name, such as FS.PAL, that you can remember.
- ➔ In *Paint Shop Pro*, open the **Colors** menu and select **Save Palette...**
- ➔ In Adobe *PhotoShop*, open the **Image** menu, select **Mode** and then **Color Table...** In the Color Table window, you'll see the FS palette displayed with some file options. Press the Save button. Color Table files in *PhotoShop* carry the .ACT file extension.

Palette Variation

As I mentioned above, you may not want your paint program to use certain colors when you apply the special effects available in your paint program. These colors include the instrument panel range, the "always lit" colors and the scenery-specific colors. Avoid these colors by creating a modified palette in which those colors have been set to black. This works because black is the first color in the palette, so the paint program will use it first. This process will take a little while and is tedious, but it is worth it.

1. Load the palette.

(In *NeoPaint* click **File | Edit Palette...**; in *Paint Shop Pro* click **Colors | Edit Palette**; and in Adobe *PhotoShop* click **Image | Mode | Color Table... | Load.**)

2. Locate color number 116.

Make that color and all the colors after it (up to number 255) black by sliding the Red, Green and Blue sliders all the way to zero for each color.

Save your palette as above, but with a new name (such as FS_MOD.PAL).

If you are making textures that will be used with the default palette only, then you may want to have a third palette that still has the higher scenery colors available. In that case, change only colors numbered 116 to 191 to black. You may do the same with the Meigs palette, Las Vegas palette or the Europe palette if you are creating textures that are to be used only with those sceneries. Save each modified palette with a distinctive name that you can later associate with the correct palette.

You will now have a palette that can be applied to the image when switching back to 256-color mode from True Color mode without adding unwanted colors to the image.

Selecting Colors for Scenery Textures

Now that you have the palette in your paint program, let's have a look at the colors available and talk a little about color selection.

As in any artistic endeavor, observation is the key to creating a realistic and believable image. After looking at many aerial photographs and with plenty of real-world "out the window" observations, it became apparent to me that the most realistic colors for *Flight Simulator* are the more subdued shades. The most predominant ones include the range of grays (colors 0 to 31), the tan shades (colors 86 to 94), the olive green range (colors 104 to 112) and, to a lesser extent, the yellow range (colors 77 to 85, although I rarely use colors 84 and 85). There are certain circumstances when the red and orange colors may be used, such as reproducing fall foliage, but otherwise the brighter colors tend to look out of place in scenery textures. There is a second range of green colors (colors 44 to 55), but I find them too bright for natural

applications, except perhaps in a tropical setting or in an agricultural context to add variety to cultivated fields.

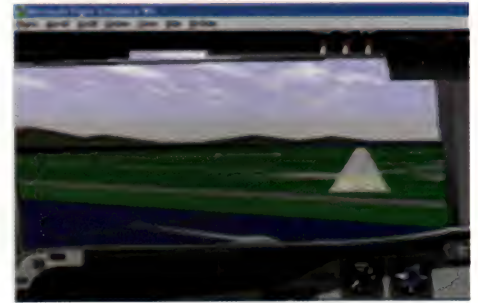
Similarly, most roads are neither black nor white, but age to a medium or light gray color. The roofs of buildings in North America tend to be medium to dark gray, while in Europe red tiles are commonly seen. And here's something else to watch out for! We say "red" tiles, but in truth they are nearer a red-brown or dark orange color. In *Flight Simulator* color 73 or color 100 would probably be the most appropriate for that application.

Painting water in *Flight Simulator* can be problematic. It is tempting to use shades of blue for all water, from ocean to duck pond. But before you do that, have a look at the water you find in your area. Does it look blue? Chances are that it's actually a shade of brown or even green. I'm sure that few things would look stranger than a bright blue Mississippi River! For such applications, try using colors 46, 78 or 88. You can use them together or try lighter or darker colors until it looks right. In general, the shallower the water, the lighter the color will be, but the speed of the water and the color of the sediment have a lot to do with the final color.

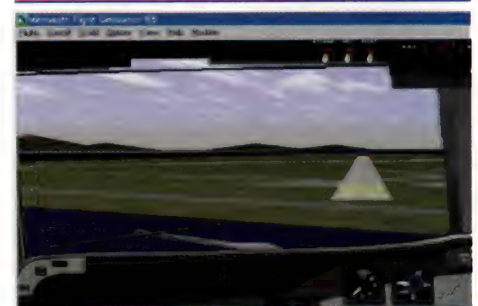


Water comes in many different colors

For wild foliage, from grass to trees, I prefer to use the olive green shades. To depict different types of foliage the general rule is: the larger the plant, the darker the overall color should be. For example, I like to use color 108 for grass, randomly mixing in a little 109 and 107, as well as 80 (yellow) and 90 (tan) using the paint program's "spray paint" tool. If this is a texture for the default palette only, I like to use colors 232, 233 and 239 as well. In my opinion, far too many *Flight Simulator* textures (including the defaults) have unrealistic dark emerald-green grass.



Microsoft's unnaturally dark green grass..."and



Something a little more realistic can be created with the right color choices

Notice that these colors all have similar values, in other words, they are all about the same brightness compared to each other. For a grassy area, which is meant to appear generally flat, this is the best approach. For a treed area, I start with a darker base color, such as 109 or even 110, and then add highlights as light as 107 (and all the colors in between). It is this use of contrasting colors that tricks the eye into seeing contours (treetops, for example) when it is really viewing a flat surface. This contrast is interpreted by the brain as the interplay between light and shadow, giving the impression of an irregular, textured surface.

The color suggestions I have made are based not only on personal observations, but also by comparing the colors found in scanned images with the *Flight Simulator* palette. However, these suggestions are only meant as a guide, and if your experience and observations lead you to select different colors, that's great. Foliage and earth colors vary from place to place. The colors I see here in western Canada won't necessarily be seen in Africa or Korea, for examples. The trick is learning to observe these things in nature and apply them in *Flight Simulator*.



Texturing Considerations

Let me elaborate on texturing effects. By placing two contrasting values of the same color adjacent to each other, we can trick the eye into seeing high and low points on our image. In general, the greater the contrast, the more change in height is perceived.



Observe the differences between the trees and the crops in this rural scene

Looking at Figure 5 above it's obvious that there is a clump of trees in the middle of the scene. Take a moment to consider what it is about the arrangement of color, highlight and shadow that tell you which part of the image represents trees and which part grass or crops. Such observations are critical if you are to achieve this effect in your textures.

When adding shadows, remember that in the Northern Hemisphere the shadow should lie to the north of the highlight to look natural, and in the Southern Hemisphere that should be reversed. However, this isn't critical, and may be ignored when creating a tile to be used universally throughout the simulator world. It is important, however, to ensure that any shadows are painted consistently. Otherwise you risk seeing shadows run in opposite directions when tiles are viewed side by side in the scenery.

Scale and details

Remember that synthetic scenery tiles are approximately two miles on each side. This varies according to the latitude of the scenery, but is a good approximation for most situations. That means that each pixel represents roughly 40 square feet of scenery. This is important to keep in mind if you are painting man-made objects such as houses or roads on your textures. It is also relevant when creating a textured forest: the highlight

representing each treetop should not be more than a few pixels across. Those who have flown *Flight Simulator 5.1* will probably recall Microsoft's first attempt at photo-realistic forest tiles. They looked like trees, but when they were placed next to urban textures, each tree appeared to be several city blocks across!

If you are creating a texture for procedural scenery (mapped to a polygon), be aware of the size of the object, and make sure that the level of detail is in keeping with the surroundings and with the way the object will be viewed by the user. I have seen textures for brick buildings that show every brick in the wall. In most cases this level of detail is overkill in a texture. Often it will create distracting interference patterns until the viewer is within a few simulated feet of the object. Even when the detail can be seen clearly, it may tend to look cartoonish and out of place among the less detailed elements of the scene.

Painting Techniques

A wide variety of tools and techniques is available to texture painters. Most paint programs include most of these features, but obviously there are variations. I will describe some of the most useful general principles as well as the relevant tools in each of the three paint programs I introduced earlier.

To begin, select a new image. In most programs this is done in the **File** menu. You will usually be prompted to enter the color depth and size of the image. Make it 256 pixels wide by 256 pixels high with 256 colors. Load the *Flight Simulator* palette that you created and saved earlier. Create the base image using the colors and techniques described above, always keeping in mind the scale in which you are working.

A good general approach is to "block in" areas of color to represent the main features of the scenery you are creating. Grass, trees, bare earth, water and so on. Simulate any contours by using a lighter shade for highlights and a darker shade for low spots. Mix into each area of color a few pixels of colors of similar brightness for variety. When painting something complex, like a patch of forest, it is best to start with the darkest colors first and then build up the

highlights by using progressively lighter colors with progressively smaller "brushes." I like to leave any man-made details until after all the natural elements have been completed.

If this texture is to be used on its own and is representing a specific area, then the way is clear to follow reality. However, if the texture is going to be tiled across a large area, there are other considerations. Remember that any features that stand out in the individual texture will make the pattern of tiles distracting and obvious to the viewer. Earlier I described how we could trick human perception by taking advantage of its ability to make assumptions about the shape of an object based on light and shadow. In this case that perception works against us. The human eye is very quick to note repeating patterns. An image that is going to be tiled should be made with evenly distributed but still random detail. This is a difficult thing to achieve, and the only way to be sure is to use trial and error. Paint the basic texture elements (don't worry about the fine details or special effects for now) and then view the texture as a repeating tile in *Flight Simulator*. Check to see what parts of the pattern catch your eye immediately, and revise the texture accordingly. Repeat the process until it looks right, then move on to the details and special effects.

Using photographs

This brief section introduces using photos to paint basic scenery tiles. It is possible to use scanned images from aerial photographs, but there are a few things to keep in mind:

- ➔ The best images to use are true vertical shots; oblique photography will tend to look wrong on the texture.
- ➔ Make sure you get permission before using another photographer's images, or better yet, take your own pictures.
- ➔ Matching the *Flight Simulator* color palette to a scanned image can be tricky. Depending on the image, you may have a lot of touching up to do to get it to look right.

- ➔ When creating generic textures, it works better to combine scanned photographic elements with a hand-drawn background than to try to create a seamless texture from a single photo.

In general I find that photos provide excellent references to paint from, but are less useful as direct input into the image.

Seamless Repetition

If your new scenery tile is to be used in a situation where it will be repeated to cover a large area, you will want to set it up so that the edges blend together seamlessly. This is actually not as hard as it looks if you follow these steps:

- ➔ Activate the Select tool in your paint program, and select the entire texture image. Go into the **Edit** menu and select **Copy**.
- ➔ Open a New Image, at least 512 pixels square. With the new image active, select **Paste** and move the copied image into one of the corners.
- ➔ Repeat the **Paste** operation three more times, moving each copy of the texture to butt up against the others until you have made a large square of four copies of your textures.

- ➔ Activate the Select tool again and drag a 256-pixel square selection box centered roughly on the middle of the large square of textures.
- ➔ Perform a Crop operation (under the **Edit** or **Image** menu, depending on the program).

You now have a texture of the proper size and image with the seams made obvious down the middle. It only remains to use your painting tools to repaint the pixels on either side of the seam until it becomes unnoticeable. The edges will be seamless since they are the edges of a square that was cut from the larger square image. Figure 6 shows a seamless repeating desert texture mapped over terrain in the *Flight Gear* flight simulator.



A seamlessly tiled desert texture in Flight Gear

Special Effects

Add Noise

At this point the texture will consist of many distinct areas of color that are still not all that natural looking. We'll use the special effects of our various paint programs to quickly remedy this situation. The following paragraphs describe the process for each of the programs in turn.

- ➔ In **R8worx**, load your texture (or .BMP image) and go into **Process**. Select the **Add Noise** feature to scramble the pixels for a more random effect. The default noise level is "3" (out of 9), and you can experiment with various settings. Just hit the **U** key to undo any experiments you don't like. You may prefer to apply different levels of noise to different areas of your texture: more for forests, less for grassy areas.

Before going into the **Process** screen, select **Mask** and you can select a color or color range to operate in. Add noise as required to one area and then go back into **Mask** and select a different range. It's a good idea to save the interim versions of your texture after each process, just in case you decide later that you want to go back and redo certain areas.

- ➔ To enable the special effects in **Paint Shop Pro**, you will first need to change the color depth. Go into the **Colors** menu, select **Increase Color Depth** and then select **16 Million Colors**.

Now you can add noise to the image by selecting **Image | Noise | Add**. Select the **Uniform** option to reduce the number of stray colors that are added to the image. I have found that Noise percentages of between 10% and 20% are the most effective. You can then either continue with other special effects or, if you're finished, load your *Flight Simulator* palette again and save. It is especially important to use one of the modified palettes at this point to avoid the introduction of inappropriate colors during conversion back to 256-color mode.

- ➔ In **Adobe PhotoShop** you must also change color depth to enable special effects. Go into the **Mode** menu and select **RGB Color**. To add noise to the image, go into the **Filter** menu and select **Noise | Add Noise**.

Set the Uniform and Monochromatic options to "on." I have found that the most pleasing Amount setting lies between 0 and 30 for most scenery texture applications. Continue with other special effects or return to 256-color mode when you're finished: select **Mode | Indexed Color**. This will pop up a requester box. In the Palette box select Custom, and for Dither select None. Press the **OK** button and the Color Table requester will appear. Press Load and locate the *Flight Simulator* palette that you need. Press **OK** again and the texture will be returned to 256-color mode with the correct palette.

*Setting up new scenery
tile so that the edges
blend together
seamlessly is actually
not as hard as it looks
if you follow these
steps.*



➔ In **NeoPaint**, load the texture image in .PCX or .BMP format. Select **Picture | Effects | Blend**. This is not as effective as some of the noise features of the other programs, but it has the advantage of not introducing new, perhaps unwanted colors into the image. Experiment with the Blend Distance option for variations. The Soften effect performs the opposite function, creating areas filled with a single color, and it can be used as a precursor to the noise effects found in other programs mentioned here. There are many other options in the **Effects** menu in **NeoPaint**, but most will not be useful for *Flight Simulator* texture painting.

Similarly, the Radius can be set to any number, but I've found that the best range is found between 0.03 to 10.0. This effect accentuates the contrast between adjacent pixels and can really roughen up a flat texture.

➔ In **Paint Shop Pro**, again in 16 Million Color mode, select **Image | Sharpen | Unsharp Mask**. As with *PhotoShop*, experiment with the sliders to get the desired effect.

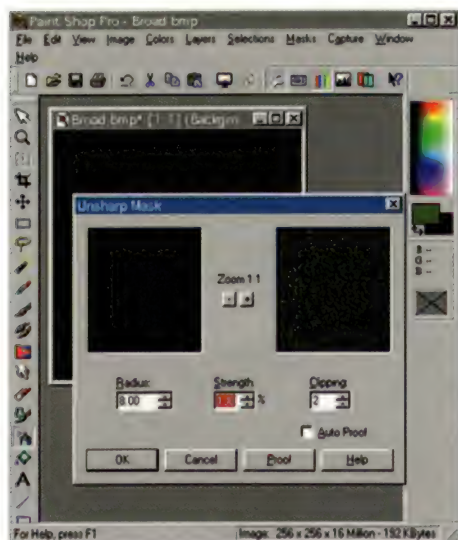
➔ In *R8worx*, select **Process** and then try the four Enhance 3D options one at a time, undoing any that aren't suitable. Each option simulates a light source from a different direction. As with the Noise function, a color mask can be set up first to isolate parts of the texture by color. For a good shadow effect, this function can be used on the texture before running it through Unsharp Mask in *Paint Shop Pro* or *PhotoShop*.

I've described the most useful basic options, but there are many more such special effects options in each paint program. You should experiment with the rest to see what you can come up with. Remember, however,

Enhanced 3-D Effects

Adobe *PhotoShop*, *R8worx* and *Paint Shop Pro* include more effects that will enable you to further enhance the 3-D texturing effects that I described earlier.

➔ In *PhotoShop*, first make sure you're in RGB Color mode. From the **Filters** menu, select **Sharpen | Unsharp Mask**. Values from 90% to 200% seem to work the best, and experimentation with the slider while watching the preview window will help you find the right level.



The Unsharp Mask effect in *Paint Shop Pro*

Resource Lists

Internet Resources related to this article:

Chris Baker's texture database at AVSIM

<http://www.avsim.com/mike/textures/pages/dbseed.htm>

Gene Kraybill's guide to FS Scenery Design

<http://www.winguide.com.au/fs/index.htm>

JASC Software, maker of *Paint Shop Pro*

<http://www.jasc.com/>

NeoSoft, maker of *NeoPaint*

<http://www.neosoft.com/~neosft/>

The *Flight Gear* flight simulator (a freeware multi-platform sim still under development).

<http://www.menet.umn.edu/~curt/fgfs/>

These *Flight Simulator* texture utilities are available at most large *Flight Simulator* FTP sites on the Internet:

R8WRX091.ZIP:

R8worx version 0.91 by Roland Weigelt. DOS mode only. Very capable program and highly recommended.

R8PAINT.ZIP:

R8paint version 1.3 for Windows. Shareware by Norm Campbell. A windows-based *.R8 editor for *Flight Simulator 5* that loads, edits and saves *.R8 texture files.

R8PAK.ZIP:

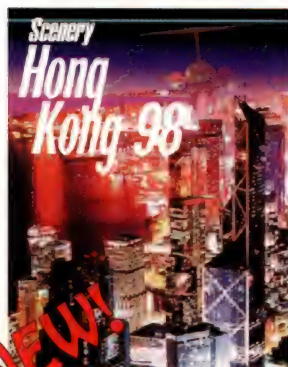
A collection of utilities for converting and modifying *Flight Simulator* .R8 texture files by Humberto Miguel.

R8_BMP_101.ZIP:

A small DOS utility that can convert *Flight Simulator* textures (*.R8, *.0AF, etc.) to Windows bitmaps and back again using a palette of your choice (by Michael Stockman).

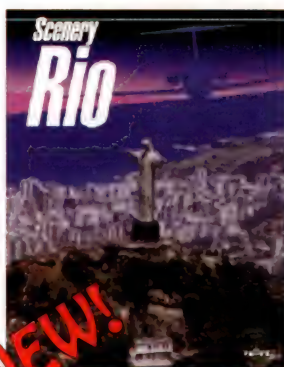
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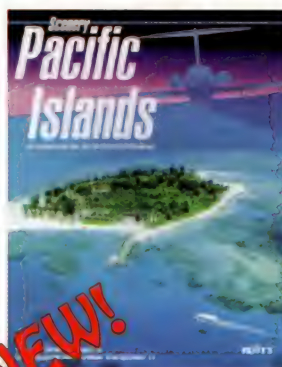
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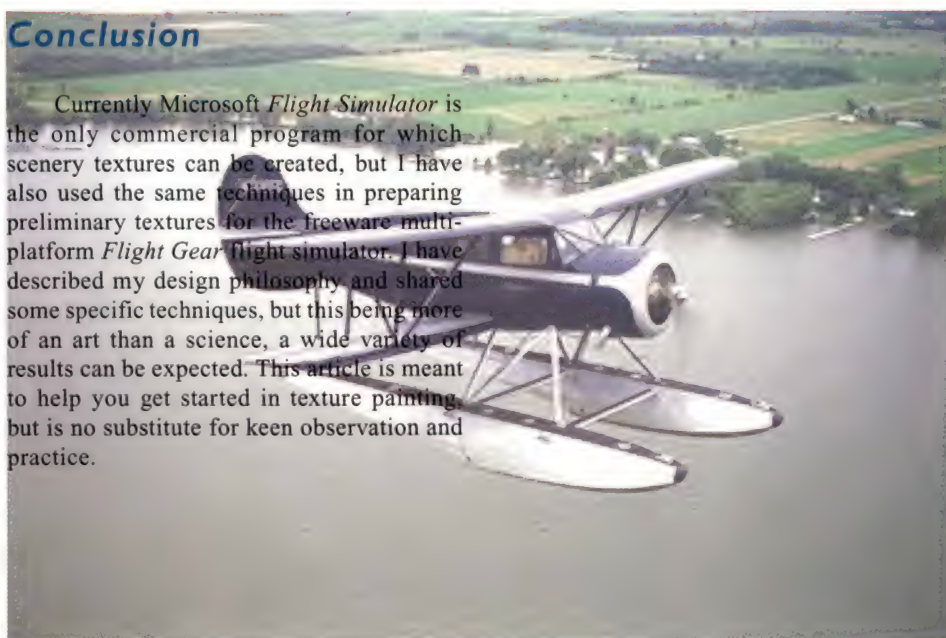
to use the features of the graphics programs intelligently. If it doesn't add realism to the image, don't use it!

Detailing and Finishing

At this point you may want to add buildings or other man-made elements to the image, or just touch up a few spots where the image processing options that you applied made unwanted changes. If you haven't already done so, create a test scenery with your texture in it and see how it looks. You may have to go back and make more adjustments. I have found that making textures, like coding scenery, is definitely a repetitive process.

Conclusion

Currently Microsoft *Flight Simulator* is the only commercial program for which scenery textures can be created, but I have also used the same techniques in preparing preliminary textures for the freeware multiplatform *Flight Gear* flight simulator. I have described my design philosophy and shared some specific techniques, but this being more of an art than a science, a wide variety of results can be expected. This article is meant to help you get started in texture painting, but is no substitute for keen observation and practice.





Design Forum

Designing and Making Scenery

by Justin Tyme

Part III Continuing To Place Your Airports

Welcome back! The previous Scenery Design Corner introduced several methods for placing airports. Today we'll complete the airport construction with runways and navigation beacons (both are details that pilots are glad to see). After your airfield is built, we'll help you work out any bugs with some tips for beta testing. Following installments will add visual details to your new airport and add life with dynamic scenery.

Synthetic Tiles

Synthetic tiles set the elevation for the scenery. Improperly used, they can cause unusual visual effects, such as floating or sunken runways, or the sim pilots may suddenly find the ground swiftly rushing up under their planes. There are situations where the floating or sunken runway syndrome is unavoidable, but we can minimize the potential problems by applying a few tricks here and there.

Ideally, and as a rule, it is preferable to maintain the airport elevation in tiles for at least 20 km surrounding the airport. With this in mind, use the largest sized tiles you can get away with. Unless textures are a concern, it is far preferable to use one size-four tile instead of 16 size-six tiles, for obvious reasons. In those cases where airports are closer than 40 km apart, split the difference.

In other words, imagine we have two airports 20 km apart with elevations that differ by 300 meters. Airport A is 300 meters high, so we want the tile elevation to remain close to 300 meters for ten km outwards to avoid the floating or sunken runway as much as possible. If we are flying away from airport A and towards airport B, which is at 600 meters, we want the tile transition to be such that neither airport will appear to be sunken or floating. When we reach the midpoint between the two airports and cross the tile boundary, the ground will rise by 300 meters. The runway behind us will sink 300 meters under the "ground," but at ten km we

are far enough away that we will not readily notice it. The runway ahead of us, which has been floating 300 meters in the air will settle down on its synthetic tile, but, again, we are still far enough away that we probably won't notice the effect.

In those cases where two airports are only ten km apart and differing in elevation by a couple hundred meters, well, either way there is going to be a floating or sunken runway. Just do the best you can in these cases. Sometimes we can put a mountain between the airports to mask the effect a bit. Sometimes there is just nothing you can do about it. This is simply one of the limitations of synthetic-based scenery.

Keeping the above rules in mind, fill in the spaces between all your airports using the largest sized tiles you can get away with. Where textures are a concern, feel free to violate the "largest tile" rule to achieve the visual effect you need.

There may be extreme situations where isolated airports may differ in elevation by 1000 meters or more. In these cases, it is

probably a good idea to use a "stepped" approach to avoid an abrupt tile elevation transition. I have set my own comfort limit at 300 meters. As our aircraft passes over a tile boundary the ground will either fall away or rush upward. Any transition more than 300 meters, in my opinion, is too abrupt. Therefore, if you need to make a 900-meter transition, it is best to make it in three increments of 300 meters, rather than one increment of 900 meters.

Again, these are general guidelines, and every situation will be unique. The trick is to strike an acceptable medium to avoid floating/sunken runways and abrupt tile elevation transitions as much as possible.

A compatibility note

Scenery designers often face the problem of making their sceneries compatible with other surrounding third-party sceneries. ASD provides a handy way to deal with these issues. You can load and display the adjoining scenery(s) as we did the default airports earlier in this series. Only in this case we will not be importing anything, just displaying it. By loading the adjoining scenery into ASD, you can make it seamlessly compatible by matching the tile boundaries along the border. If the other author has also used ASD to create his scenery, chances are that even the roads and rivers will meet perfectly. If they do not, you can easily edit your map to match them up. The **Load BGL Files** feature of ASD is a powerful utility, and I encourage all designers to take advantage of it.

Fine tuning the airports

Now that we have placed all our rough airports and synthetic tiles, let us return to the airports and fine tune them. In Map View, right-click on one of the airports we have created and choose **Properties**. You should have already filled in the fields under the Airport tab, but now it is a good time to double-check your work. If you have used

the Import method to create your airport, the Country, City and State fields are already filled in, but since we are using the default AFD, we are not even going to concern ourselves with these fields. The AFD entries already exist for these Imported airports, and creating another AFD file will only create duplicate entries in the FS98 Airport and Facilities Directory.

ATIS & UNICOM

Now click the ATIS tab. Refer to your reference source to see if this airport has an ATIS frequency. If so, put a checkmark beside "ATIS enabled" and plug in the frequency and range in the appropriate box. I usually reduce the default 80-nm ATIS range to 40 nm. Fill in the appropriate runway numbers (questions? Click the "Help" button), then insert the desired ATIS message strings.

If the airport does not list an ATIS frequency (and most small airports do not), check your reference source for a UNICOM frequency. Most airports will have one of these. Plug in that UNICOM frequency, reduce the range to 15 or 20 nm, designate your preferred runways, and insert the desired message strings and custom text. Your end-user will appreciate such

information as "Fuel Available" and any available ILS or localizer runways and frequencies here. For added realism you can check your reference source for Airport Remarks and add such text as "Birds and Deer in vicinity of airport," if applicable.

(In a future article, I will explain how to implement a scenery-wide AWOS system that is especially useful if your end-user has installed Real Weather 5.x, for even greater realism.)

Still in the Airport Properties dialog box, click the Visibility tab and make sure to Set Visible Range to a value of 20,000 meters or less. This will help with memory and frame rates issues. Now click the Diagram button at the bottom of the Airport properties dialog box.

Runway properties

Whichever method you have used to create your airport, you should now see at least a runway and Airport Property polygon. If you have used the Import method, most everything should already be set up. All runways, taxiways and ILS should already be implemented if you have imported the airport properly. This is one of the great time-saving features of the Import method. Most of the work has already been done for you.

If you have used the “scratch” method, we will have to fine-tune the runways and manually configure the menus and ILS. Right-click on the primary runway and choose **Properties**.

Runway tab

Here you will configure your runway’s surface type, heading, length, width and identifying number. (You can also add Land Me capability here.) You will find all this information in your reference source.

Enter the appropriate values for each parameter. Remember, ASD is asking for the True Heading in this tab. You’ll have to compute this value by referring to the published magnetic heading and adding or subtracting the magnetic variation, depending on whether the variation is listed as east or west.

If your runway has a published magnetic heading of 10 degrees and the magnetic variation is 10 degrees west you would subtract (east=add) the magnetic variation from the magnetic heading to arrive at the True heading. In this example, the true heading would be 000 or 360. [Airnav.com](http://airnav.com), a web-based reference source, lists both magnetic and true heading for many runways, making this much less confusing.

Lighting tab

Click the Lighting tab. Again, check your reference source and input the appropriate values. You must activate Threshold lights in order to add any sort of approach lighting. Your reference source will tell you what type of runway and approach lighting belong on both ends of the runway.

VASI/PAPI

Your reference source will give you this navigation light information. You can also adjust the default spacing of the lights.

Features

The information on this tab further configures your runway. Sometimes this data is not listed in the reference source you are using. Most of it can be found in the Airport & Facilities Directories put out by NOAA, usually available from your local Fixed Base Operator (FBO), as mentioned in an earlier installment. Sometimes this information is buried cryptically in the airport’s entry listing, but you can figure it out by referring to the legend in the front of the publication.

FS5 & FS95 menu

Here you enter the information that you want to appear under the main entry of your scenery in the FS5 & FS95 menu system. Many third-party flight planners also use this information for their airport listings, so even if you are creating FS98-only scenery, it is a good idea to enable these menu listings. Put a checkmark beside Enabled and fill in all the information. Note that this tab is asking for the *magnetic* heading of your plane when the menu entry is chosen. ASD will calculate this value using the internal FS

magdec value based on the True heading you entered under the Runway tab. The COM, NAV and OBI values can be found in your reference source. Keep the threshold offset to 100 ft. or less in most cases. ASD usually automatically calculates this, but if you have dragged, rotated or otherwise changed the placement of the runway, you may have to reset this value. If you find that your plane is not sitting on the end of the runway when you check your work in FS, simply recycle the runway by right-clicking, choosing **Properties**, rechecking the values in the menu tab and clicking **OK**. This should reset the runway and straighten out the menu entry.

If you are working on an airport with multiple runways, you might prefer to only enable the menu entry for one runway and leave the others disabled. If you designate a menu entry for every runway, your menus will quickly become cluttered.

You might also prefer to have your menu entries originate at a terminal or apron instead of the end of a runway. Each Polygon Properties dialog box also has a menu tab for this case.

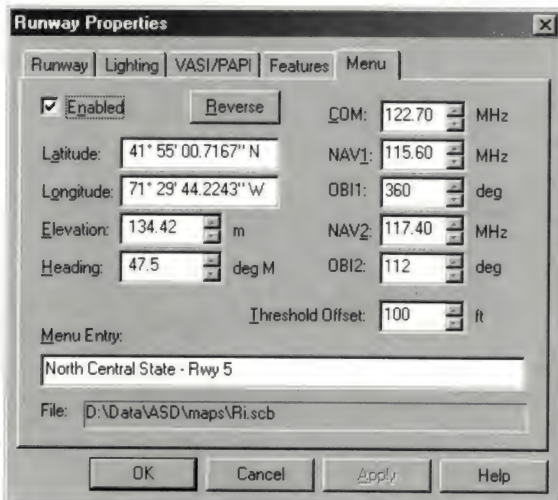
Also, if your airport has more than one runway, you’ll probably want to put the primary runway “on top.” In the Airport Properties dialog box you will find a Runways tab, which lists all the runways at the airport. Here you can adjust the display order of each of the runways.

Now click **OK** to save your information and close the Runway Properties dialog box.

ILS

Pull down the Insert tab and choose ILS. The resulting dialog box will show the possible runways at the airport where an ILS can be placed. Again refer to your trusty reference source, put checkmarks beside the applicable runways and click **OK**. You will immediately see blue and/or magenta dots on the runway(s) you chose from the Insert menu. The blue dot represents the localizer, and the magenta indicates the glideslope. Double-click on either to configure the ILS.

The most essential piece of information in this dialog box is the ID. Omitting this parameter is one of the most common mistakes, resulting in an error when you



compile. *Make sure you fill in this box.* The name field should already contain the name of the airport, but you should add the specific runway number to which the ILS is attached. Use information found in your reference source to fill in the correct frequency. The default range of 25 nm is usually acceptable.

Click the ILS tab. Not all ILSes have a glideslope. If your reference sources do not indicate a glideslope, uncheck this. Not all ILSes have DME capability. If your reference source does not indicate DME capabilities, check None.

Most glideslope have a 3-degree angle, though special cases may be steeper or shallower. Again, check your reference source. Most ILS specifications also include the TCH (Threshold Crossing Height). If you know the TCH and glideslope angle, ASD will precisely calculate the touchdown point of the glideslope.

Click the markers tab. If your reference source lists markers associated with this ILS, insert them here. [Airnav.com](http://www.airnav.com) is probably the best source for ILS information (if you have internet access, bookmark <http://www.airnav.com>—you will be using this source often).

Offset localizers

Many runways, especially in mountainous areas, have offset localizers. These may be located in some odd place off the runway centerline, with a heading several degrees off the runway heading. ASD has a method for dealing with these situations.

Under the VOR tab of the ILS Properties dialog box, you can change the heading of the ILS. You can also locate the localizer somewhere other than the runway centerline by dragging the ILS dot while depressing the **(Shift)** key. Refer to your reference source for this heading and location information.

That wraps up the fine tuning of airports. Remember that if you have 100 airports, you will be doing what we have just done here 100 times. Depending on the size and complexity of the airport, you could spend a couple minutes or a couple hours configuring runways, communications and navigation features.

ASD Tip

It is a good idea to save your map, compile and execute your batch file after completing each airport. This will insure that you do not lose your work, and if you do have a compilation error somewhere, you do not have to look through several airports to track down the error. It will also mean that you will always have the most recent version in your FS working scenery directory. *Edit, Save, Compile, Execute*, over and over as the project progresses. During the course of a major scenery project, you will make thousands of repetitions of this basic cycle: *Edit, Save, Compile, Execute*.

good workout. Also, these serious simmer-pilots should have access to their own real-world flight publications or know where to find the information. In this manner, they can act as an independent cross-checker to ensure that you have accurately portrayed the numerous ILS frequencies and approach procedures built into your scenery.

The perfect beta-tester is a real-world instrument-rated pilot who is familiar with the area your scenery represents and who has lots of time on his or her hands. You can post a message on any or all of the various flight-simulation mailing lists and newsgroups, and with any luck you will find a half-dozen dependable testers.

In the next installment, we will add the visual details. We will flesh out our airports, build mountains, lay out cities, and bring our scenery to life with dynamic scenery. See ya then ...

Ready for Beta 1 Testing

Now that we have laid the foundation and constructed the basic framework of our scenery, it is now appropriate to begin beta testing. No matter how careful and meticulous we are, errors are bound to happen, and making your scenery available privately to several beta testers before releasing it publicly is always a good idea.

Keeping in mind that we are still a long way from completion, testing can now begin. Ideally, phase 1 beta testers should be competent, serious simmers, preferably real-world pilots with instrument experience or at least familiar with instrument flying, and should have the time to give your scenery a



Design Forum

Homebuilders Corner

by David Lewis

As promised last time, this issue sees the start of the step-by-step project to build a Tiger Moth, using the *Flight Shop* package. So, let's clear out the hangar to start work!

Start up the *Flight Shop* aircraft factory application. From the **File** menu, select **Create Project Directory**, and name it "TMoth."

Now you've got the hangar ready. Which part will you build first? Like any project, it's good to have a plan. I usually start with the fuselage, then wings and tail, engine(s), wheels, and finally the "extras," like flaps, spoilers, antennae, etc. The reason for this order is that *Flight Shop* has a complexity limit; any aircraft can only include a restricted number of parts. I try to use those parts where they will make most difference to the appearance of the plane. If there are not enough parts left to add a Pitot tube, it won't matter too much!

Before putting anything into FSFS, we should decide how many pieces we'll use to build the plane. Look at the fuselage as an example: the side view shows it cleanly all the way from engine to tail, and FSFS would happily accept that as a single structure. So why break it up? To fit the limitations of paint and glue.

**Thinking of designing your own aircraft?
David Lewis' primer will get you started...
This time it's paint and glue**

Paint

Paint, in this case, is the application of bitmap textures to the surface of the aircraft. *Flight Shop* has some (relatively) easy paint facilities, but only for specifically shaped bitmaps. All bitmaps are stored as 256 by 256 pixels. They are split in half for the left/right sides of a plane or the top and bottom of a wing. So the usable shape is 256 pixels wide by 128 high. It is also possible (as you'll see later) to divide the bitmap into four square pieces of 128 by 128. That can be useful for the left and right sides of a wheel, along with the air intake of an engine or some other square-ish part.

Flight Shop only allows ten bitmaps per aircraft, so this kind of doubling-up may be necessary to get the right appearance. Also, several parts can be painted with a single bitmap, but a single part can't be painted with more than one bitmap.

So, what difference do these paint limits make to the splitting up of the fuselage into parts? Well, if you kept the fuselage as one single piece, it could only have a single

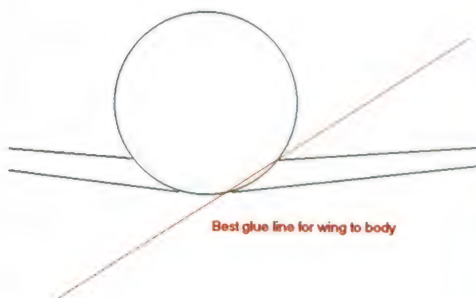
bitmap applied. That would be 256 pixels from nose to tail. It may be acceptable on a small plane like the Tiger Moth, but would be no use at all for a 747. Even the stock MSFS Cessna has two bitmaps applied to the fuselage, making the body 512 pixels long by 128 high.



In general, you should aim to divide your aircraft into sections that are twice as long as they are high, each of which can be painted with a bitmap.

Glue

"Glue" is a handy term invented by the *Flight Shop* designers to describe the joint between two parts of a plane. Picture the left wing of a plane: when you stand to the left of the plane, the wing may hide part of the fuselage; but when you stand to the right of the plane, the fuselage hides most or all of the left wing. There is an imaginary line where the two parts meet. Stand on one side of it and the wing hides the body, and on the other side the body hides the wing. Deciding where that line should be is what *Flight Shop* refers to as "gluing."



Where to draw the glue line is not always obvious. On a 747, the wing is attached low on the body. The obvious line to use is a simple left-right divide at the joint. However, the 747 has a wide body, and viewed from above the body should hide the wing root, even from a position left of center. A better choice would be the literal line of the joint.



Why do we need to understand all this? Because MSFS doesn't understand it! Given the definition of two parts, MSFS could work out for itself which one is nearer to you, and hide the other one. But that would take time

and slow down the simulator, so instead all those decisions are made when the aircraft is built.

And why are we looking at it now, before you've built a single part? Because the glue effect only applies to whole pieces of the plane. Your plane may be a complex shape, so that part of the wing should hide part of the fuselage, but a different part of the fuselage hides part of the wing. Maybe you have a bent wing, like a Stuka or a Corsair, and the wingtip needs to hide part of the fuselage even when the wing root is hidden under the fuselage. MSFS can't do that if the whole wing is a single part (or component, or structure, see picture).



To build that kind of complex shape, the pieces have to be smaller. Bent wings usually have to be built in two parts, divided at the bend. Now the wingtip can hide the fuselage when the wing root doesn't. (The wingtip can also hide part of the inner wing, which is good!) The best time to think about the gluing is before you start building parts.

Four Kinds of Glue

There are four ways to specify the gluing of a *Flight Shop* aircraft: assembly group, component, automatic and manual. Let's look at each one in turn.

Assembly groups are large pieces commonly found on aircraft. These include the fuselage, low wings, high wings, nose, tail, etc. When you create a part (or component or structure), *Flight Shop* lets you assign it to an assembly group. Because these

large pieces are always in the same relation to each other (a high left wing is always higher and further left than the fuselage), *Flight Shop* can do automatic gluing between assembly groups. This is an easy and convenient way to specify the relationships between parts.

Within assembly groups you can have *parts* (individual polygons), *components* (collections of polygons) and *structures* (extruded shapes). The purpose of parts is obvious, and structures are a very easy way of creating solid shapes. But why collect parts together into components? Once again, it's related to glue. Even pre-defined gluing takes a little time to evaluate, and components are a way of having no glue at all! The parts within a component must be arranged so that none of them can hide any of the others. No glue is applied, so the simulator simply draws each part in turn, without considering which order they should be in. This is a good way of speeding up the display of very large numbers of parts.

As an aside, structures also work with no internal glue. Because they are solid, with all faces turned outward, it should not be possible for any surface of a structure to hide any other part of the structure. However, you might try building a concertina-shaped structure, and check how well that works. Even structures need splitting for glue sometimes!

So much for what happens inside individual components and structures. Gluing is between parts, components and structures within an assembly group. If you don't specify the glue (manual gluing), *Flight Shop* will have a guess at where it should go (automatic gluing). The principle that *Flight Shop* applies is this: find the center of each part; glue the two parts with the two nearest centers together; treat these two as a composite part, and calculate a center for the composite piece; repeat until all parts have been glued.

There are two ways for automatic gluing to go wrong. The calculation of centers works fine for single parts. But the center of a combined part is somewhere near the joint between them, which may lead to later problems. The combined center may even be in empty space in some cases. The



calculation of gluing lines is also approximate, being half way between the two centers.

This is especially true when the sizes of the parts vary. If FSFS glues a small thing (like a strobe light) onto a big thing (like a fuselage), the glue line is somewhere inside the fuselage. Anywhere above the line, the light may be shining through the body of the aircraft.

Usually though, automatic gluing works fine. When it doesn't, you can tell *Flight Shop* how to glue. This is achieved with a "glue polygon," just like a triangle of double-sided sticky tape. It has to be a triangle, because glue works in three dimensions. All you have to do is to position it between the two parts, and it fixes the glue decision at that joint. Later in the construction there will be some manual glue to be defined.

The Tiger Moth

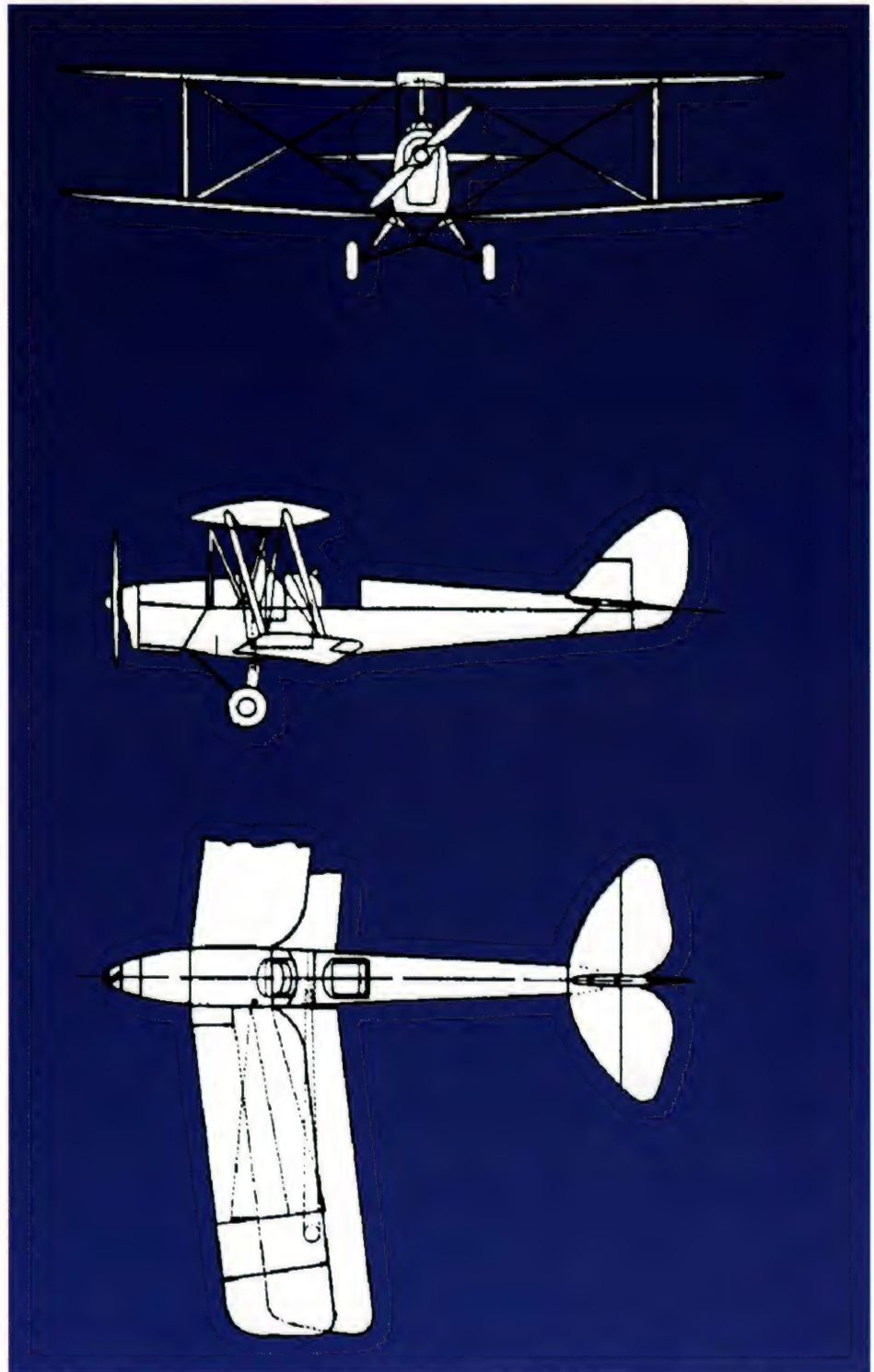
Let's look at the plans of the Tiger Moth.

Thinking about glue reveals many separate parts: the fuselage, the prop, the prop spinner, the tail, the tail fins, the tail struts, the top wings (should they be one piece or two?), each of the lower wings, each wheel, each strut. Many of these fit into obvious assemblies.

With most planes, it helps the gluing if the fuselage is divided into at least three parts: one in front of the wings, one from leading edge to trailing edge, and one behind the wings. In the Tiger Moth's case this applies to the lower wings, but the upper ones are clear of the fuselage, so they don't need this treatment. It would be different if both sets of wings were attached to the body, as on some biplanes.

The Moth's fuselage is a peculiar shape; it has cut-out pieces for the two cockpits. It will help the gluing if the fuselage is cut into separate pieces at each of these points as well.

There are no problem pieces (like engines mounted in the wings), so there should be no need to divide any other parts for the sake of gluing.



Now consider the paint requirements of the Tiger Moth. The fuselage is roughly five times as long as it is high. Each texture is twice as wide as it is high, so that suggests we should use two and a half textures. Since

the half texture will apply to the tail area, which is roughly square, that could work quite well.

We'll look at the divided fuselage again next time, when you get to build it in the Aircraft Factory.

The first part

Let's get started and build the lower wings with a step-by-step description. I measured the lower wing from the plans, and the knowledge that the wingspan is 29', 4" lets me scale it as follows:



There's a complication to the wing: it has a dihedral, which means it slopes up toward the wingtip. (When the wing slopes down it's called an anhedral.) The dihedral angle is 4.5 degrees. There are two ways of dealing with this in *Flight Shop*: create a wing that slopes up, with interim heights for all the points on the curves, or create a flat wing and fix it on with a dihedral later. The first option is easier to think about, but will almost certainly lead to a wing that is not quite flat, and also make it more difficult to create moving ailerons later (if we get that far!). The second option is easier to do, but needs a small calculation to allow for the dihedral.

I've chosen the second route. Since the wingspan is 29', 4", but the wing angles up, the wing is effectively a little longer than that. All the left-right distances on the wing must be multiplied by $1/\cosine$ (dihedral).

The dihedral on the lower wing is 4.5 degrees. Cosine of that is 0.99-something, and one over that is 1.003—a number so near to one that we can ignore it! Not too difficult after all!

To build the wing part in *Flight Shop*, select the Parts button from the main *Aircraft Factory* menu. There are lots of ways to make this, but since everything's already measured, I like to enter the dimensions as numbers. Click on **Create | Data Sheet**, and enter the numbers in the table below:

-1.0,	-2.7,	-1.6
-1.0,	1.6,	-1.6
-13.7,	0.1,	-1.6
-14,	-0.2,	-1.6
-14.7,	-3.4,	-1.6
-13.9,	-4.3,	-1.6

Select **View | Top** and **Zoom | 1/2** to get a proper look at the wing. Overall I'd say it looks quite good, but the rear wingtip is not quite round enough. Let's fix that by manual positioning. Click on **Rework | On Screen**, which puts a circle around the first point of the shape. Hit the right arrow key four times to get the circle to the wing tip. Now hit the Insert key. The circle jumps to a new point, half way to the next corner. Put the mouse somewhere on a smooth curve, and click to move the new point. I ended up with a position of (-14.5, -4.0, -1.6) for the curve edge.

Save this part by clicking **File | Save As** and giving it a name of "LLWING" and description "left lower wing."

Unfortunately, it still isn't right. A closer look at the side view of the Moth shows that the wing is visibly higher at the front than the back. Rather than doing the calculations as before, let's fix this one by eye. Select **View | Side** and **Rework | Point Editor**.

This is the numeric way to correct positions. Select the first point on the list, and change the "Up" value to "-2.5." Press Enter, and Click [OK] to remove the window. Notice how the one point is now lower than the rest of the wing.

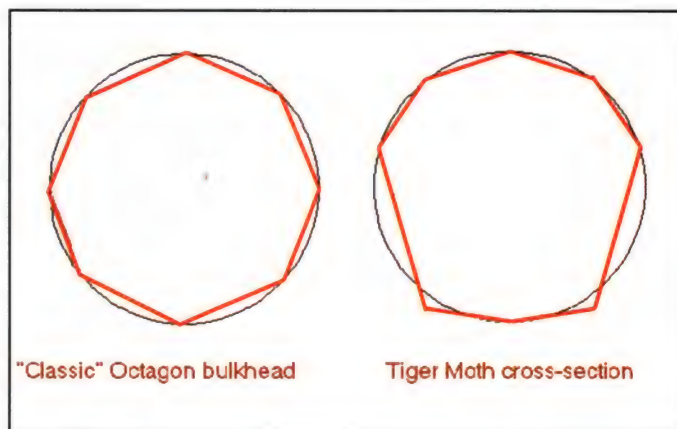
Next select **Rework | On Screen**. Press the right arrow to move to the third point. Remember that it is at +0.1 forward (check it with the mouse if you're not sure—the position shows in the small window). Now move down to a position 0.1 forward, but on the line between the first two points. I make the height -1.9. Press the right arrow and go on to the next point. Try to get them all in a straight line. When you've finished, click **File | Save** to store your changes.

Congratulations on building your first part. Now exit from *Aircraft Factory*, with a job well done.

Next time we'll build the fuselage. Before then, try measuring it from the drawings to see whether you get the same answers as me. Also, measure up your own plans and start work on an aircraft of your own.

Problem planes #2—it's not very round, is it?

This issue's problem is how to tackle aircraft whose fuselage is not cylindrical. *Flight Shop Aircraft Factory* has an easy way of creating most shapes of aircraft fuselage. Simply copy the side view and top view from your plans, save them as templates, and create a structure. This builds a solid fuselage with the correct side and top views, and a



simple cross-section. The cross-section is chosen from a selection of "bulkheads" supplied in the system, including octagons (not a bad approximation to a circle), rectangles, diamonds, etc.

The Tiger Moth cross-section is almost flat at the base, the widest point is much higher than half way up, and the top is rounded. An eight-point cross-section would suit it very well, but not the standard *Aircraft Factory* octagon. The diagram below shows what I mean.

There is only one solution to this kind of shape, and that's to build it as a component out of separate parts. Create the side and top templates as usual (as a guide). Decide where the bulkheads would go in a structure and number them. Now create eight parts, titled "FnnA" to "FnnH" (where nn is the bulkhead number) for the polygons in the section.

I start with the top-left polygon. Looking at the side template, draw in the top-front and top-rear points, both on the aircraft center-line. The other two points should be at the widest point on the fuselage, so switch to a top view to position them. Then switch to a side view and move them down to the correct height for the widest part of the fuselage. Save this as "FnnX."

Next switch to a front view, and move the lower pair of points upward and in toward the center, to give the correct upper curve. Save the result as "FnnA." Open FnnX for rework, and move the upper pair of points to the same place, and save the result as "FnnB." Repeat the process for the lower half to create FnnC and FnnD. Now open each part, and use the point editor to create a mirror image with positive Right/Left values instead of negative ones. Save them as "FnnE" to "FnnH."



1. Side view with point selected



2. Front view with point selected



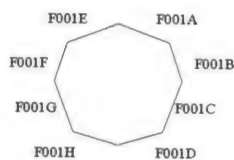
3. Front view with one point moved



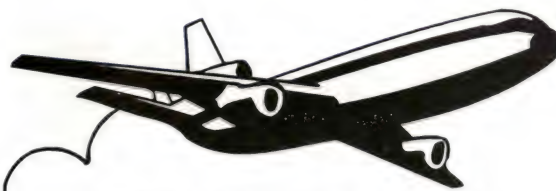
4. Select next point



5. Second point moved to overlay first point



6. Naming of parts (front view)



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If you need bulkheads at front and/or back to be seen, create them and save them as "FnnI" and "FnnJ."

Finally, go into the component editor, and create a new component out of all the parts you have just created. Call it "FnnCMP" and give it a description of "Fuselage comp nn." Repeat the process for the other sections of the fuselage.

This is a lot harder work than using structures, but creates a much more realistic body shape. Clearly, it is unnecessary for basically round bodies, like most commercial transport aircraft (apart from double-deckers like the 747). Since this uses up your allocation of components, you will have to look at using structures for other things, like the wheels. We'll look at the complexity limits of *Flight Shop* in another issue.

The Last Flying Super

By Tim Dickens

The Lockheed Constellation is one of the most beautiful airplanes ever built. Five "Connies" are still flying now, four of them in the United States. The actual number of operating Connies varies, depending on mechanical condition. The Connie's unique 123-foot wing span, four radial engines, triple-tail design and graceful dolphin-shaped fuselage create a breath-taking sight for classic aircraft enthusiasts.

In its day the Connie reigned as queen of the skies because it was the first plane that flew coast to coast non-stop and was pressurized. The Connie set new records for size and speed. In April 1944, a C-69 Constellation made world headlines when Howard Hughes and Jack Frye of TWA astounded the world, setting a transcontinental commercial record by piloting the largest land transport plane ever built from Los Angeles to Washington, D.C., in seven hours, three minutes. All the major airlines flew Connies, including TWA, Pan Am, Air France, Eastern, Lufthansa, Capital, Western, Qantas and many others.

Without organizations such as this,

these timeless masterpieces from

the aviation world of the past

would be relegated to neglect and

ultimate deterioration past the

point of no return.



The *Star of America* is currently painted in the authentic TWA scheme of the time, but the director of the Save A Connie museum, Dick McMahon, emphasizes that the museum is in no way affiliated with TWA.

The military, spanning three wars, including World War II, Korea and Vietnam, also used the Lockheed Constellation. Many Connies were built as civilian air cargo transports, too. A total of 856 Connies were built between 1943 and 1958, encompassing four model variations. They were used extensively by both the military and civilian airlines until the early 1960s.

Lockheed designed the Connie in the early 1940s according to the specifications of Howard Hughes, for commercial use by his TransWorld Airlines. Built in 1959, the *Star of America* Connie, displayed at the Save A Connie (SAC) air museum at the Kansas City Downtown Airport, is one of just a handful of Constellations still flying, and to my knowledge, is the only flying Connie in original commercial airline configuration.

Save A Connie, Inc. is a not-for-profit, all-volunteer organization dedicated to restoring, preserving and exhibiting propeller-driven commercial aircraft. Kansas City, located in the heartland of America, was the world headquarters for TransWorld Airlines for many years. The historic hangar/office building with its inlaid brick "Thunderbird" logo still appears much as it did in that era. In the executive offices of that building, TWA President Jack Frye and major stockholder Howard Hughes made the plans to design and build the Constellation. Kansas City is a natural



Constellation Airliner

the aircraft to the Save A Connie organization in 1986. After more than 135,000 man-hours of volunteer labor and donations from classic airliner enthusiasts around the world, *Star of America* has proudly flown to airshows around the United States and Canada since 1989. When she is not at a show, *Star of America* can be seen at the SAC Museum at Kansas City Downtown Airport. This beautiful aircraft has also starred in a television commercial and the international movie *Voyager*, released in the United States in 1992.

home for the Historic Aircraft Museum and for the restoration work done on these beautiful classic airliners. The vast wealth of propeller airliner knowledge and experience available in Kansas, due to the large number of TWA retirees living in the area, is unmatched anywhere in the world.

Save A Connie's first project was the painstaking restoration of this Super Constellation, model 1049G, built by Lockheed in 1959. 26 years later it was deteriorating in the Arizona desert when Mr. Paul Prito acquired it at an auction for \$4,000.00. Mr. Prito donated

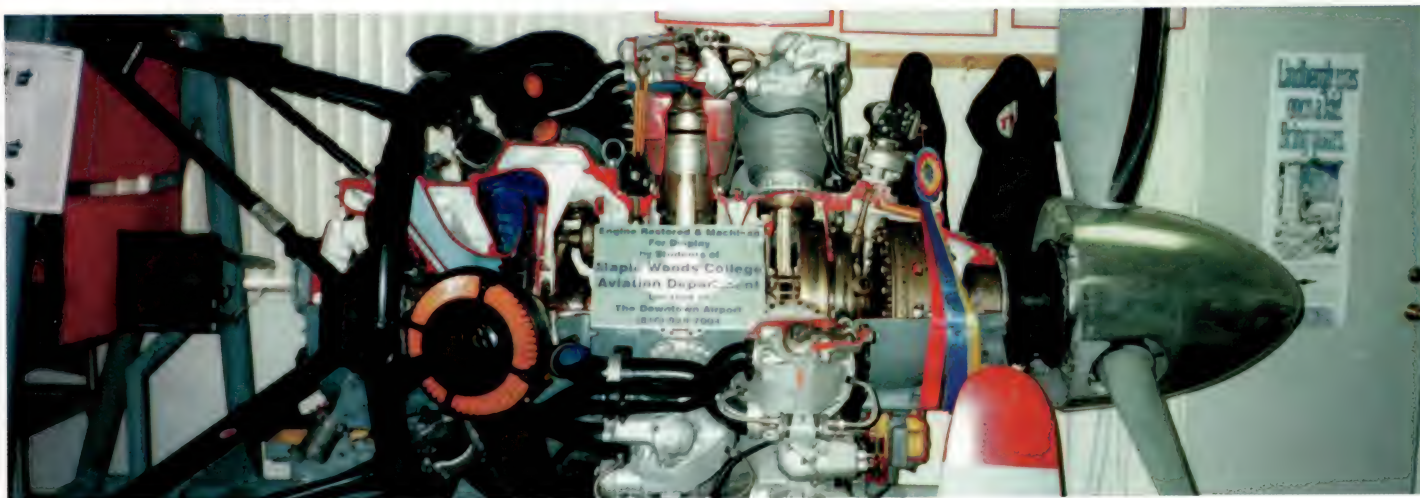
This Historic Aircraft Museum is open Monday through Saturday, 10:00a.m. to 3:00p.m. local time, and visitors are treated to a unique window into the world of commercial aviation in the 1950s for a modest suggested donation of \$2.00. The Museum contains a collection of photographs, artifacts and printed and audio/visual material. Uniforms, galley items, instrumentation, and a full-size cutaway Wright 3350 eighteen cylinder double radial engine are on display (see photo top of next page).

The Museum also displays commercial aviation memorabilia dating back to the 1920s and the dawn of commercial air transport. (See photo next page.) A wonderful video presentation, "The Rebirth of the Super Constellation," details the rescue of *Star of America* from the desert and her restoration. This video is also available for purchase in the museum store.

But the highlight of the tour, by far, is visiting *Star of America* herself. The Save A Connie team has done a spectacular job of recreating both the exterior and interior of this classic airliner. In many cases, the original seats, fixtures and equipment from actual Connie airliners have been used.

The cockpit has not only been restored with original instrumentation, but also upgraded with the required modern avionics to meet current FAA requirements.





The Museum also displays a full-size cutaway Wright 3350 eighteen cylinder double radial engine (top left) and commercial aviation memorabilia dating back to the 1920s and the dawn of commercial air transport (middle photo).



In many cases, The Save A Connie team uses the original seats, fixtures and equipment from actual Connie airliners (bottom photo).



The second restoration project of Save A Connie was a Martin 404 manufactured for Eastern Airlines in 1952. It was one of 103 Martin 404s manufactured by the Glenn L. Martin Company of Baltimore, Maryland, and was the twelfth 404 purchased by Eastern. The aircraft was operated by Southern Airways for many years, who eventually sold it to Systems International Airways. The Martin 404 was designed for short to intermediate flights of 300 to 700 miles. Its seating capacity of 40 was all designated "first class." It features a pressurized cabin, air conditioning, carry-on luggage racks and self-contained aft-loading stairs. Full meal service was available for even the shortest flights.

This aircraft was acquired by SAC in 1990 and joined *Star of America* at airshows starting in 1993. The Martin was named *Skyliner Kansas City*. The same painstaking care was taken to restore this classic aircraft to original, authentic condition. (see photos on the next page).





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This aircraft was acquired by SAC in 1990 and joined Star of America at airshows in 1993. The Martin was named Skyliner Kansas City. The same painstaking care was taken to restore this classic aircraft to original, authentic condition (middle and bottom photos).



Currently, the Save A Connie organization is busy restoring a vintage DC-3 aircraft to its original operating condition. This DC-3 is a truly historic airplane, in every sense of the word. The Douglas Aircraft Company delivered this aircraft, number NC1945, to TWA on March 4, 1941. It became TWA's plane number 386.

The DC-3 was the airplane that moved the airline business from a young, unreliable, uncomfortable mode of transportation, oriented toward the wealthy and adventurous, to a dependable form of transportation for the general public.

This aircraft had been wasting away in the desert sun near Roswell, NM, the UFO capital of the world. Only in this case, it was an IUO (Identified Unflying Object). This vintage aircraft was literally rotting away and had deteriorated to an absolutely deplorable condition. The inside of the fuselage looked like the back of my garage!

The neglected DC-3 cost Save A Connie \$14,500 to resurrect from aviation purgatory and another \$8,000.00 to transport back to Kansas City.





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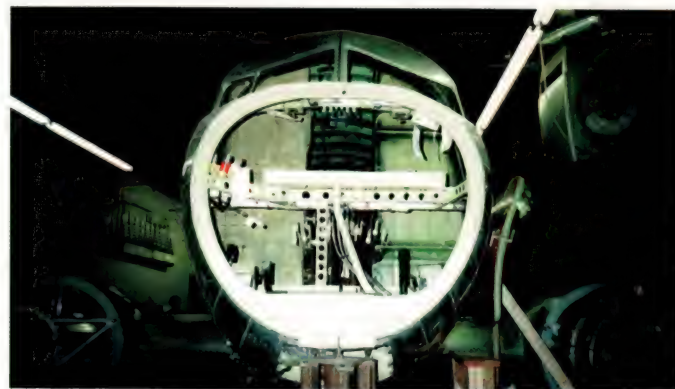
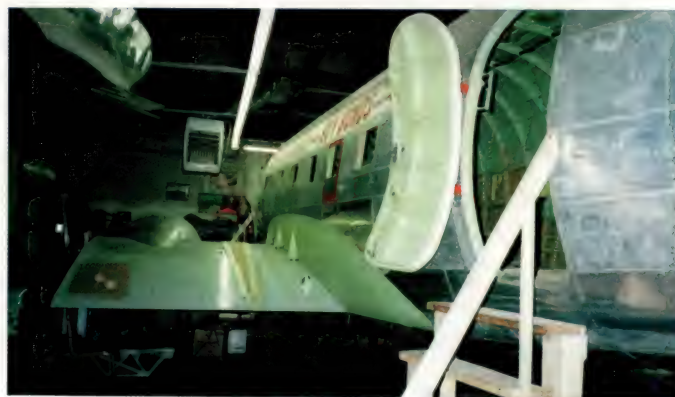


Restoration is now being done in a special rented hanger. The DC-3 costs almost \$6,000.00 in materials and equipment to renovate, raising the total project cost so far to \$37,500.00. This is surely a labor of love for the volunteers of this organization, as donations for the project, as of this date, total only \$10,000.00. Undaunted, the Save A Connie volunteers are making tremendous progress on the restoration of this aircraft. The DC-3 fuselage has been torn down to its barest essentials. Even bulkheads and stringers have been removed and refurbished. The interior of the fuselage now looks like an aircraft (instead of my garage). The control cables have been identified and restored. Almost all of the aircraft's aluminum skin has been duplicated and replaced, panel by panel (see series of photos on the next page).

But there is much left to do, such as small details like purchasing, rebuilding and installing two engines and refurbishing and attaching the wings. The crew estimates that the DC-3, which will be named *Victory*, will be ready to join *Star of America* and *Skyliner Kansas City* on the airshow circuit in about two years.

The Save A Connie organization represents the vanguard of classic aircraft restoration and preservation. Without organizations such as this, these timeless masterpieces from the aviation world of the past would be relegated to neglect and ultimate deterioration past the point of no return. Unless these aircraft are rescued from this fate and volunteers from today's modern jet aircraft age take the time to learn the technology of yesterday, future generations will be cheated from experiencing the rich heritage of that golden era of aviation, experiences that we can still enjoy...for now.





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Photographs used in this article are used courtesy Save A Connie (SAC) air museum at the Kansas City Downtown Airport.

By Jim Rhoads

The '90s—what a great time to live. The technology available to the common person is nothing less than incredible for most of us. From computers to household items, technology has advanced so fast it's sometimes hard to imagine the way we used to do things.

The same is true for navigation. Global positioning satellites make navigating much easier and much more reliable. I laugh thinking about sharing my opinions on GPS with some of the old timers. I usually get a reaction similar to "What do you need that for? Back in my day, we used a map and a compass, and then NDBs came along." And now comes GPS. I'll keep the map beside me, and I still have a compass on the dash, thank you.

GPS promises to significantly enhance many of the functions provided by current positioning and navigational equipment, but

*GPS promises to significantly
enhance many of the functions
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with greater accuracy and lower costs. Mapping, aerial refueling and rendezvous, geodetic surveys and search and rescue operations will benefit from GPS. Such capabilities were put to the test during operations Desert Shield and Desert Storm. Allied troops relied heavily on GPS to navigate the featureless Saudi Arabian desert. Forward air controllers, pilots, tank drivers and even cooks used the system so successfully that several U.S. defense officials cited GPS as a key to the Desert Storm victory.

GPS is a constellation of orbiting satellites providing navigation data to military and civilian users all over the world.

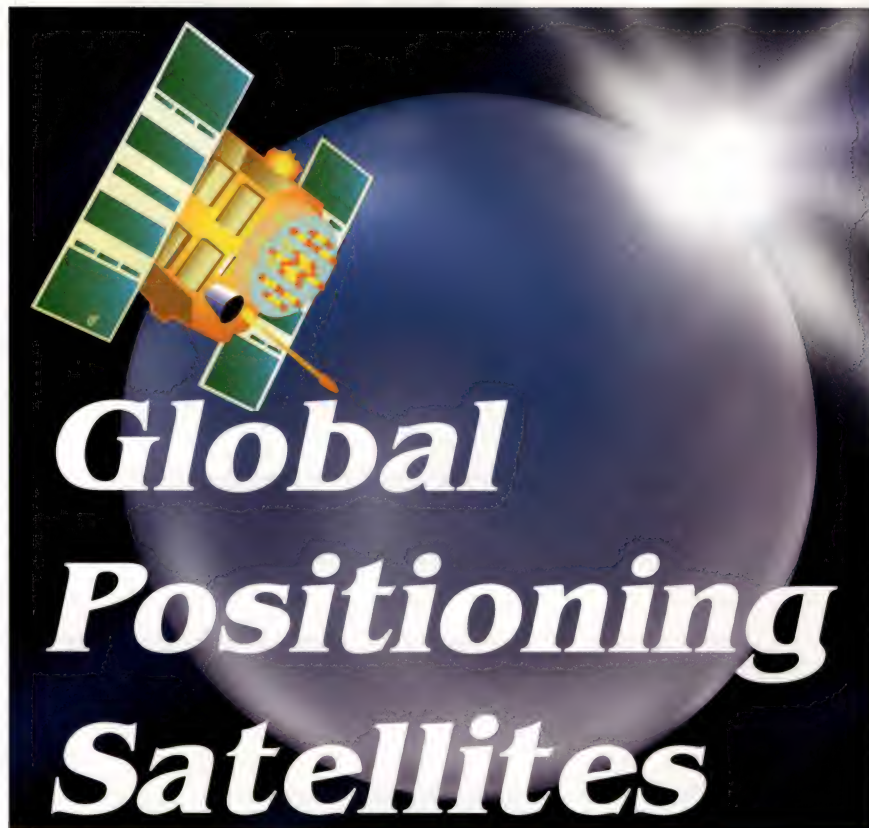
GPS provides 24-hours navigation services which include:

- ➔ Extremely accurate three-dimensional location information (latitude, longitude and altitude), velocity and precise time.

- ➔ A worldwide common grid that is easily converted to any local grid.
- ➔ Passive all-weather operation.
- ➔ Continuous real-time information.
- ➔ Support to an unlimited number of users and areas.
- ➔ Support to civilian users at a slightly less accurate level.

24 GPS satellites orbit the earth every 12 hours emitting continuous navigation signals. With the proper equipment, users can receive these signals to calculate time, location and velocity. The signals are so accurate that time can be figured to within a millionth of a second, velocity within a fraction of a mile per hour, and location to within a few feet. Receivers have been developed for aircraft, ships and land vehicles. Hand-held models have even revolutionized the sport of fishing!

There are two main types of GPS receivers: Multiplexing Receivers and Parallel Channel Receivers. These terms refer to how a receiver gets and processes information from the satellites. Keep in mind how GPS works: a receiver must lock onto and measure the signals of at least three different satellites in order to navigate (this is called triangulation). By measuring the travel time of the signals transmitted by these satellites, multiplied by the speed of light, a GPS receiver on earth can determine its precise distance from each satellite being tracked. By locking onto the signals from three satellites, a GPS receiver



can calculate your current latitude and longitude. If a fourth satellite is available, a GPS receiver can also calculate your altitude.

Multiplexing Receivers use a short cut to achieve triangulation. They establish contact with a satellite only long enough to sample its data, and then they hunt for another satellite to sample and acquire data, and then a third and possibly a fourth. All told, this process would take, at least, several seconds. In order to provide a one second update, most multiplexing receivers grab an update from a couple of satellites and make a "best guess" at the position update.

Multiplexing receivers

Multiplexing receivers are the least expensive types of GPS receivers because they cost less to build. Unfortunately, this savings results in less accurate positioning responses to changes in direction and speed. With only one channel to receive, the information has to be pieced together and then averaged. Because of all this switching, multiplexing receivers tend to have more problems finding and keeping contact with satellites in areas covered by foliage (the woods) and where parts of the sky are blocked by mountains, hills, trees, cliffs, slopes, or even tall city buildings.

Parallel Channel Receivers

Parallel Channel Receivers, on the other hand, maintain a constant simultaneous lock on several satellites at once, eliminating the switching inaccuracies of multiplexing receivers. A parallel channel receiver holds all the navigational information you need for the most reliable, up to date and accurate information possible.

GPS Accuracy

Because GPS was designed as a military navigational system, the Department of Defense created two transmission codes: the "P" code (Precision Code) for military use and the "C/A" (Civilian Access) code for civilian use. The highest accuracy levels were to be reserved for the military to prevent hostile enemy attacks against the U. S. using our own navigational system. However, once in operation, the civilian code proved to be more accurate than the DoD had intended. Consequently, the military developed a system for randomly degrading the accuracy of the signals being transmitted to civilian GPS receivers. This intentional degradation in accuracy, controlled by the DoD, was named *Selective Availability* (S/A).

It should be emphasized that all brands of civilian GPS receivers are equally affected by S/A; no manufacturer has an advantage. The government has stated that with S/A turned on, civilian GPS accuracy levels will consistently be 100 meters or less, 95% of the time. The other 5% of the time, the accuracy will be 300 meters or less. However, typical accuracy for most users averages between 20 and 50 meters the majority of the time.

S/A is a random error, intentionally input by the military. It can be low or high and varies in degree at any given moment. When on, this deliberate accuracy degradation can represent up to 100 meters. With S/A off, civilian GPS accuracy levels increased to 15 meters or less. Even with Selective Availability on, most GPS users experience typical accuracy much closer than 100 meters. You can easily see the effects of S/A on a GPS receiver when you are not moving. Typically, there will be random movements in speed, altitude and position readings, along with jitter in the plotter trail, easily seen when you are on a .1 or .2 mil Plotter range and not moving.

Differential GPS (DGPS)

Although there's a strong possibility that S/A will be turned off completely in the future, Differential GPS, or DGPS, has been developed to improve GPS accuracy to within

Satellite Specifications

Spacecraft	3-axis stabilized, nadir pointing using reaction wheels. / Dual solar arrays supply 710 watts (EOL). / S-Band (SGLS) communications for control and telemetry. UHF cross-link between spacecraft. Hydrazine propulsion system.
Payload	Two L-Band navigation signals at 1575.42 MHz (L1) and 1227.60 MHz (L2). Each spacecraft carries 2 rubidium and 2 cesium clocks. Also carry nuclear detonation detection sensors.
Country of Origin	United States
Customer/User	U.S. Air Force
Manufacturer(s)	Rockwell Space Systems.
Size	5.3 m across with solar panels deployed.
Orbit	20,200 km circular (12-hour period) / 55 deg. inclination / 6 orbit planes.
Design Life	7.5 years



a few meters. Originally initiated by the U. S. Coast Guard, DGPS adds a land-based reference receiver, located at an accurately surveyed site. Since this non-moving DGPS reference station knows where the satellites are located in space at any given moment, as well as its own exact location, the station can compute theoretical distance and signal travel times between itself and each satellite. When those theoretical measurements are compared to actual satellite transmissions, any differences represent the "error" in the satellite's signal caused by S/A.

All the DGPS reference station has to do is transmit the error factors to your DGPS receiver, which gives the information to the GPS receiver so it can use the data to correct its own measurements.

How it works

GPS accuracy is a result of the development of high-speed, inexpensive microprocessors. The computers in the master control stations have to be able to make accurate, complex calculations incorporating position, time and speed, as well as thousands of items of data, and do it quickly. This is vital for the users to be able to find their actual positions instantly. Previous microprocessors were too slow to calculate these complicated formulas at the rate necessary for accurate position measurement, but now technology has reached a level at which this can work efficiently.

To find out how far the are from the stations, the satellites send out radio signals, relaying their names and the times on their clocks. The signals spread out around them, like spherical ripples. The time delay, from the satellite to the point where the stations receive the signal, is proportional to the distance the signal traveled. When the stations receive the signals, they compare the message time to their current time and calculate the distance from the stations to the sending satellites. A new message is returned to the satellites with this information.

When the satellites know where they are in relation to these known locations on the ground, they do several things. First, they send out the navigational information to any user receivers in the area. Second, the same information goes to several monitor stations.

The monitor stations check the figures, looking for discrepancies. The data passes through a master control station, to be corrected, before going back to the control stations. The satellites pick up this new information and learn where they are, then send the data to the users and to the monitor stations. The data is corrected and goes back to the upload stations, and then the cycle begins again.

The satellite signals go to many receivers, and each receiver picks up many satellites at once, so satellite positions are constantly being checked against positions of other satellites, and the same thing happens for receiver positions.

Pilot's perspective

OK, that's enough of the technical stuff. As a pilot, what makes me want to choose GPS in favor of other navigational aids? GPS provides the shortest distance by drawing a straight line to the chosen destination, instead of plotting from VOR to VOR or likewise with NDBs. I love the ability to actually see the class airspace rings on the screen, so when I report I am 20 miles out, I know I am. In addition, I can accurately report when I am leaving the controller's airspace or transitioning it. GPS gives me accurate DME to my destination and even gives me estimated time of arrival! I can constantly monitor my track and bearing to the destination. I can see how fast I am flying (knots or mph). I can zoom in or out on my moving map display or autozoom to allow the screen to focus in larger as I reach my destination.

If I am in trouble or get a weak bladder, I can toggle the GPS to give me the ten closest airports in order. With two clicks, it will display the bearing to the one I select. I can even track conventional nav aids such as VORs and NDBs with my GPS.

GPS provides the shortest distance by drawing a straight line to the chosen destination, instead of plotting from VOR to VOR or likewise with NDBs.

Do you want to set up a flight plan? No problem—it's easily done with the magic box. Select route and plug in your waypoints, then save and run it later. Got an airport that's not on the map, but you have the latitude and longitude coordinates? Set it up as a waypoint and let Scotty beam down a signal for the box to hook. And if you don't have time to fumble with your directories, the magic box has all of the pertinent communication frequencies and runway information available with a couple of clicks.

I can hear the old codgers now: "Why, something like that takes all the work out of flying."

Yep, I agree. This system has proven highly accurate, is not affected by weather and provides me with vital information. As opposed to other systems that are more vulnerable, less accurate, and are scheduled to be removed in the near future, I will pick GPS.

I feel that I am a safer pilot using GPS, primarily because I am well informed and spend less time burying my head in the cockpit. Don't get me wrong. I still swing needles even though I use my GPS. The prudent navigator doesn't rely on one source of navigation. I always have the closest VOR and ADF plugged in, as well as occasionally cross-referencing occasionally with the VORs.

Ah, yes, living in the '90s is a wonderful thing. It makes you wonder what the navigation of 2040 will be and what I'll be saying to the young navigators while I sit in my rocking chair and tell them how tough we had it.



Garmin at a Glance

By Tim Dickens

During the summer of 1996, residents of Olathe, KS, such as myself, saw an open field transformed into the skeleton of a modern structure. Everyone was betting on what this incongruity in the midst of a rustic setting was going to be. Smart money was wagering on a shopping center. I thought from the beginning it was going to be an office or manufacturing facility, and I was proved right when the final structure started to take shape. Imagine my surprise when their sign finally went up along the roadside, proudly announcing this as the new World Headquarters of the Garmin International Company, one of the leading GPS manufacturers! How about that? An aviation-related manufacturer right here in my hometown!

Since this issue presents a feature on GPS technology, I thought it would be a good idea to see if I could get an inside look at their operation. Suzanne Cole, Senior Media Liaison, was gracious enough to invite me in and provide a first-hand look at designing, manufacturing and distributing GPS systems.

I was surprised to learn that Garmin, formerly located in Lenexa, Kansas (just down the road) actually manufactures and distributes over 40 different products, serving the aviation, automotive, marine,

military, survey/GIS and outdoor/sportsman markets. Nearly 1,400 distributors and OEMs (Original Equipment Manufacturers) worldwide sell their products. Garmin also has subsidiary offices and manufacturing plants in the UK and Taiwan. Their first product was delivered to the market in January 1991. To date, they have sold over one million units worldwide.

Two executives of the King Radio Company, now known as Bendix/King, (a division of Allied Signal Aerospace, Inc.)

The GNC300XL panel mount is an advanced GPS unit.

founded the company with just a handful of people and an idea for a product. Gary Burrell, President, and Min H. Kao, Ph.D., Vice President of Engineering (hence the name Garmin: Gar(y)-Min) have since built Garmin into an international presence.

Mr. Burrell is a licensed pilot. He has been recognized as the Emerging Entrepreneur of the Year for Missouri and Kansas by *Inc. Magazine*. Mr. Kao has devoted more than 18 years of his career to

developing GPS software algorithms and architecture. He is credited with the breakthrough design and engineering of the patented MultiTrac8 GPS software technology that established the foundation of the original Garmin line. As an engineer with the King Radio Company, he led the development team for the first GPS navigator certified by the FAA. He has also explored GPS technology in several works published by IEEE Press.



Plainly, the Garmin Company is standing on very solid ground of both engineering background and company creditability. But the story goes much further than that. I was treated to a tour of their office and manufacturing facility here in Olathe, and I was impressed with the depth of their engineering and manufacturing facility, as well as their support and technical staff.

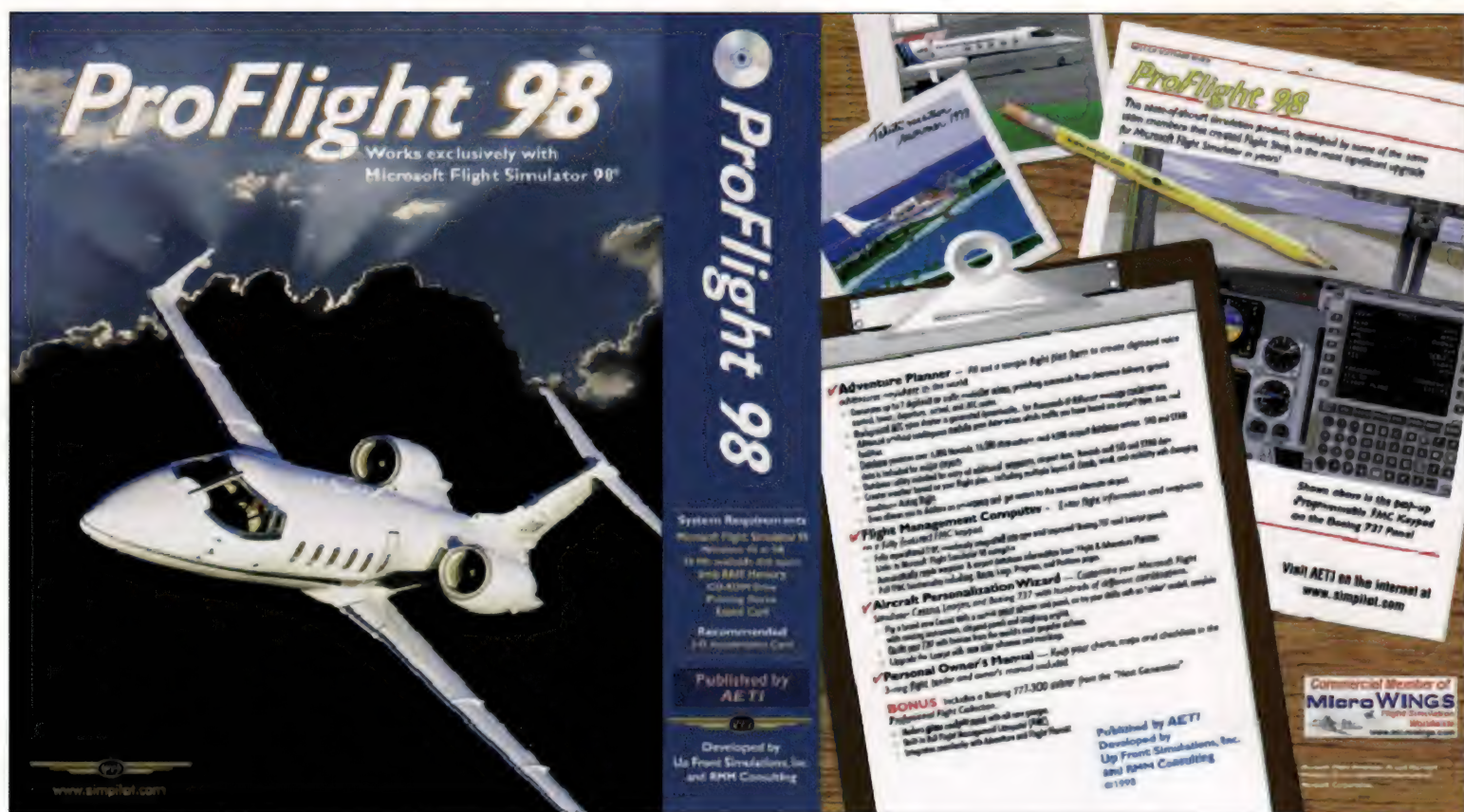
Garmin is truly committed to the development and support of high-quality products equipped with superior safety and operational features. Since I have a background in the engineering and manufacturing of high technology electronic medical equipment, I have quite a bit of experience with what it takes to develop and support equipment which *has* to work in the field. The first thing I noticed in my tour of their plant was the amount of physical space and personnel that comprises their quality control (QA) department. I have seen QA facilities in the medical industry which consist of some disheveled guy sitting at a greasy workbench running 50 units simultaneously while reading the newspaper, waiting for something to start smoking. If it doesn't start a fire or cause a short on the main circuit buss, it passes. And this is considering that the GMPs (Good Manufacturing Practices) for the FDA are *at least* as exacting as those of the FAA.

It was not so at the Garmin Company. I was delighted to see a number of people working at what was obviously a well organized, protocolled set of regular assigned tasks, both at component level and at assembly level. I also noticed several RFI (Radio Frequency Interference) cages, which resemble chicken coops. This means that they were not only testing for electronic/mechanical reliability, but also for *image rejection* (the ability to sort out unwanted radio signals), which would obviously be required for a GPS receiver. And I was quite impressed by the fact that they were doing circuit board design and manufacturing as well. You would be surprised to know how many manufacturers in the electronic industry farm that work out. This gives the Garmin design and QA team quite a leg up, in my opinion. From an engineering point of view, I would feel very confident flying with one of their GPS units.



Garmin also manufactures a very broad line of quality IFR and VFR instrumentation (IFR on the left and VFR below) as well as handheld GPS instruments (bottom).





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My tour of their facility continued with a look at their Cartography department, where I observed quite a number of people busy developing reliable maps to work in conjunction with the software for their more advanced GPS units, like their GNC300XL panel mount.

I understand the need for developing reliable cartographic information from my experience in creating scenery for MS *Flight Simulator*. Information from just one source (like the *US Geological Survey*) can be useful, but only if you understand that it is not *really* 100% accurate. A city or county survey (which is inherently more accurate), for example, will often show a road or a river several 100 feet (or maybe even 1000 feet +) off of the USGS coordinates. In *Flight Simulator*, you can live with it. In real world navigation, this is not good. Hats off to all of

their efforts making this information more accurate, enhancing safety and accurate navigation.

Of course, the bottom line for any product you buy these days, from can-openers to computers, is the customer support you can expect from the manufacturer. After peeking into Garmin's Customer Support Department, I say with a high degree of confidence that their end-users have no need for concern. Quite a number of personnel and resources are dedicated to this very important function. This is the hallmark of a quality organization.

I would be remiss in not mentioning that Garmin also manufactures a very broad line of quality IFR and VFR instrumentation, as well as handheld GPS instruments.

All in all, I very much enjoyed the tour of the Garmin facility and the inside look at what it takes to produce a quality GPS

navigation system. If all manufacturers of aviation navigation equipment follow the same level of care and attention to quality/performance that Garmin does, we can all feel very secure, as both passengers and pilots, that the aircraft is where it is supposed to be (and headed in the right direction). From my point of view, Garmin certainly *is* headed in the right direction.

Announcing

Full Throttle's Shareware Registration Center

Thousands of flight simmers have discovered and are using many of the great flight sim shareware add-ons and utilities.

Shareware is written by some very talented and dedicated programmers. These programmers devote a tremendous amount of time and effort to writing, maintaining and enhancing their programs. You may not know that most shareware authors do not make a living from their flight sim activities. Instead, they depend on their shareware income to help defray their expenses. In turn, thousands of us willingly pay for their contributions towards making our flight sim experience easier, better, faster and more enjoyable.

Shareware is also a low-cost way to distribute software. You can download the software and try before you buy. If you find that you like the program then you can "register" your purchase by paying a low-cost registration fee. Most shareware authors are more interested in writing programs than in running the "business" end of shareware.

For the convenience of our readers and as a way to promote some very excellent shareware, we've set up the **Full Throttle Shareware Registration Center** to process shareware

registrations *immediately* for these authors. Several well-known shareware authors have already agreed to participate through our Shareware Registration Center.

You can register participating shareware in one of several ways:

- ➔ Call our Toll-Free Line:
800-821-1707 (from US & Canada)
- ➔ Call our International Line:
616-554-7275
- ➔ Fax our 24-hour Line:
616 554-7279
- ➔ Send e-mail:
sales@ftmagazine.com

We can accept your payment for registration using any of the four major credit cards. For phone orders, our staff will give you a registration number immediately. For fax and e-mail, you'll receive a registration number within two days.

The registrations are then sent to the respective shareware authors who will in turn keep you advised of any future enhancements.

Attention Shareware Authors:

If you'd like to participate in the Shareware Registration Center, please contact **Full Throttle**.

Shareware Registration Center



Shareware Registration Center Participants

Moving Map for FS98

By John Hnidec

Registration Fee: \$25.00

This all-in-one instrument displays aircraft position, airspeed and altitude as well as navigation aids and airport data on a large easy-to-read display.

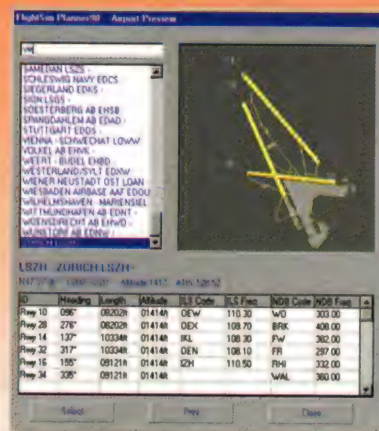


FlightSim Planner 98

By Sascha Felix

Registration Fee: \$25.00

Plans flights automatically or manually from a database of 10,000+ airports. Print flight plans, pertinent airport information and diagrams via the easy-to-use interface.

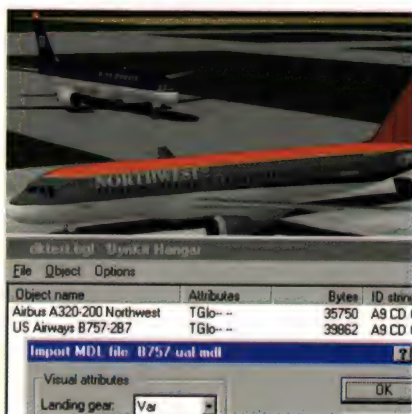


DynKit

By Konstantin Kukushkin

Registration Fee \$99 for commerical use

This is a set of tools for creating new dynamic object shapes such as new aircraft or vehicles. These objects can be used to enhance dynamic scenery in FS95 and FS98. Aircraft made with Flight Shop are easily converted into dynamic object shapes and are then inserted into existing dynamic sceneries. Also includes support files for manually writing low-level code for new object shapes with SCASM and for creating dynamic scenery with FS98 (for experts).



GaugeDump

By Bruce Hellstrom

Registration Fee: \$20.00

GaugeDump is a tool for panel designers who'd like access to the details of the FS98 gauges. GaugeDump creates a complete "C" source file of an existing gauge which you can then modify to add additional details and features.



Experiencing The Ultimate Airliner Simulation

By Peter James

In constant pursuit of my need to fly the heaviest of iron, I want to offer everyone my recommendations for the files you must have to turn FS98 into the "Ultimate Jetliner" simulator. Most of the files I mention are freeware downloads off the internet. Some are not, and I am classifying the commercial ones in the "must have or don't even bother" category.

After you get FS98, you'll give the default 737 a try. That's a good place to begin, but just by itself, I don't consider it by any means "complete." Here is what I recommend.

Let's start with the things you will have to spend money on. Get some good hardware. Throw away that fighter pilot's joystick and get a civilian yoke and rudder pedals. The CH Products lineup of the **Virtual Pilot Pro and Pedals** is a winner. I have owned them for years and can tell you that for the value, they can't be beat by anything less than several hundred dollars. Lately I've been using the new Suncom **Strike Fighter Series Throttle**. Don't let the name fool you. This is the best jetliner pair of twinjet throttles I've ever used. Most serious flight-simmers have at least a yoke, so if you're happy with that and don't want to go broke right away, go on to the next step.

Get a 3DFX card. With 3-D capability, FS98 takes on the professional graphics of an airline, not to mention the frame rate boost you'll receive. Without 3DFX, you'll be flying in a patchwork land of jerkiness,

and your eyes will ache from the 2-D pixelation. The new Voodoo II cards are recently available. However, I have seen users report frame rates not much better than the Voodoo I cards, and at the \$250 price tag, some users are upset they even bothered getting one. So, I'd say spend \$170 or so on an original Voodoo card like a **Diamond Monster 3D**, and you'll be all set. An excellent feature on 3-D hardware technology and products is included in this issue.

Now that the costly first step is taken care of, the rest is affordable and easy to obtain. Get a good aircraft. I can not say enough for the Project Freeware Group's creations. All their jets are originals, with the best flight qualities and visual graphics of any airliners I've flown on FS. You can find them at <http://www.avsim.com/mike/pfree/index.html>. Once you try these jets, you'll never fly the default 737 again. You can download MD80s, 90s, 737s, 727s, 767s, 777s and many more. You can pick the make and model and can select from all the world airlines as well. Some of my favorites are the USAir 737-300s and -400s, any of the 727s, and the British Airways 777-200. In 3-D, the paint jobs shine in the sunlight. The flight qualities are rock-steady and fly with the utmost realism.

Personally, I like to fly 747-400s. At this time Project Freeware doesn't make them. Until they do, search the net for any 747s made by Robert Randazzo. You can't go wrong—all of his 747s are excellent. Robert

works for a major airline and has been at the controls of 747 simulators for years. His files are on most Web sites. Visit www.flightsim.com and search the file libraries.

Once you pick some airliners to keep, you must get good panels to go with them. Many panels have been

released in the last few months, but only a few designers have captured the feel and functionality of the actual thing. I will now mention the panels you must have!

Being a real airline pilot, Eric Ernst knows how to make a panel! All of his panels are more functional than any other panels I've seen—even commercial ones. He has panels for commuter props all the way up to 747 styles. They have workable radio altimeters, fast/slow needles, changeable CRT displays and many new colors. All panels are



easily downloaded and installed per the usual method. The extra detail in Eric's panels will drop your frame rates a bit, but I think you'll find them worth it! His site is <http://www.flightsim.com/efpanels>.

Another great source for panels is www.simflight.com, which has a directory for the FS98 panels. The nicely arranged format is full pictures of the panels, so you can see them before you spend time downloading them. We can't forget the haven of files, www.flightsim.com. There you can browse all directories for the exact categories you wish.

If you need help installing FS98 aircraft and panels, a comprehensive tutorial is at the *Full Throttle* Web site, at <http://www.ftmagazine.com>.

After you have selected airliners and panels, you're almost there. I have found two more utilities that are indispensable for my airline flights: David Drouin's **GPS 3.1** for FS98 and **GPWS and Airliner Cabin Announcements** for FS98 version 3.0 shareware and freeware utilities. You can find these at www.flightsim.com.

First let's talk about this famous little GPS program.

After installing the files per the instructions, you will

program, you'll get more functionality, and you will be able to use GPS without registration messages when you start the program. This is an easy and realistic unit to have on all your flights. You can let its autopilot command take control of your aircraft's heading and plan for various audible alarms to wake you up! It's perfect for planning overseas journeys, where you can enter in an entire oceanic track. This opens up a new door for FS98 airline pilots!

Until GPS came out, I used to use the famous GPWS version 7 for FS98. That came with an extensive navigation system, ground proximity warning system and some cool in-cabin flight attendant callouts. Just last week I came across the new Cabin Announcements and GPWS version 4 file by Adam Rock. You can also find this at www.flightsim.com.

This big 5.5-Meg file contains a much improved version of the previous program but without the navigation. Well, since I have the GPS running all the time, I have made this new adventure the only thing I have running during the flight. Once you startup this nifty adventure, you will be able to select about 15 different in-flight sound effects. Basically you'll be using pre-recorded .WAV files taken from real flights.

You can activate pre-pushback checklists, taxi-out safety briefings from the video monitors, seat belt on/off "dings," takeoff and after departure checklists, etc. You can even listen to realistic external jet sounds. By tuning to 118.02, you will hear the roar of various departing jets. This is especially effective to use during a taxi on a parallel taxiway.

The standard Ground Proximity Warning System that so many of us have used the last year or two is still included. Radio altitude callouts, windshear warnings, off-glideslope callouts and a complete autoland system work fantastically. You can still hear random ATC in the background if you tune to 118.00. Those of you who fly with ATC controlled flight won't be able to use this utility. But since I prefer to "control myself," this adventure beats everything I've used before.

Whenever flying a heavy jet, I just couldn't imagine flying without a GPWS running. It has saved me numerous times from having a near miss or worse in bad weather. Its terrain warning and windshear system is a must if you fly with realistically

challenging weather conditions. Real pilots use the altitude countdown feature all the time to judge when to start the flare for landing, and cut to idle. If you have not tried flying with one, do so! You will find your landings much easier to make.

Despite the complexity and quality of **747-400 PS1** simulator by Aerowinx, I still prefer flying the big jets in FS98. The reason is the "total experience." The visuals in FS98, especially the ability to look around and to the rear corners to view your wings, does something for me.

In real life, I fly with my head on a swivel. In FS, I "have" to do the same. To not do so, just doesn't feel right. There is something to say about breaking out of fog and clouds at night, screaming through Cirrus clouds at 500 kts, making a visual approach to Hong Kong over the city, or watching myself from a control tower view as I taxi. My ears are happy when I hear the roar of wind, the rattling of a touchdown and the thumping of 18 wheels falling into place over a beeping outer marker. This just beats all other simulations hands-down for the total experience.

I know I can't get the systems, emergencies, button-pushing jollies, ATC and FMS programming that PS1 offers, but the whole flight is much more realistic because FS98 offers something for all your senses. My most memorable real-life piloting moments have to do with things I saw or felt. We can't yet feel any flight sim, but my "feelings" come from the visuals I remember and the flight quality. PS1 has equally good flight quality as an FS98 jetliner, but with the lack of visual graphics, the entire flight experience falls short.

I hope soon we will have all the features of a PS1-type sim and FS98 combined into one awesome jet airline simulation. Until then, I'm devoted to the 100 or so airliners sitting in my FS98\aircraft directory! That's a lot of weight!



see a
moveable
and sizable
graphic on
your
windshield.
Just drag and
place it to
where you want,
anywhere on

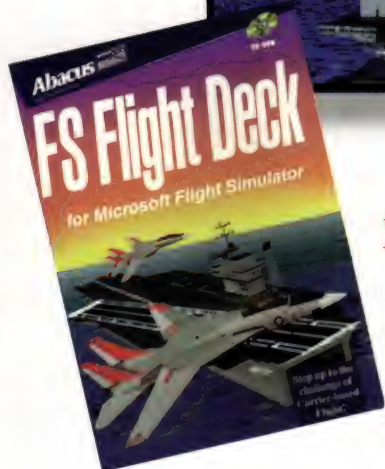
your panel. Then you can stretch and resize it as big as you like! Now, you're ready to use it. It is basically self-explanatory. You will be able to program one or more stations based on airports, VORs and intersections. You can get information about frequencies, runway lengths and dimensions, waypoint and airport distance and time remaining, ground speed, a visual CDI, and even winds aloft at your altitude! If you register this

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ASD's Map View lets you visualize the layout of your scenery—much like a bird would see it. Using a map, you can easily add many other realistic features—roads, rivers, buildings, beacons and more. When you're designing large areas, you can quickly and flexibly "lay down" your choice of textured scenery (e.g. wooded, prairies, water). And ASD's specialized mountain and coastline tools enable you to create breathtaking vistas.

ASD's Group View lets you add detailed features to non-airport areas, so you can build your own towns and cities away from the airport grounds. You can position any of ASD's built-in 3-D objects precisely in your scenery. And since ASD is designed to be extensible, you can also add other 3-D objects (SCASM-compatible macros available from other sources) to your sceneries.

The final product is what counts—which is why professional designers throughout the world rely on *Airport & Scenery Designer*. For unmatched ease-of-use, flexibility, performance and features, there's only one choice: *Airport & Scenery Designer*!



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A Round Robin Adventure

By Al Pelletier

Hi Flight-Simmers,

Welcome to the 1st Round Robin (RR) written for Full Throttle magazine.

This RR takes place in the Toronto/Montreal/Ottawa Canada area. I flew it with Microsoft FS98, though it can be flown with any Flight Sim that has the required airports and nav aids.

This RR uses Microsoft's default FS98 scenery and the TORMONT4 scenery, designed by Henry J. Garbacz. It can also be flown in any simulators that have the required nav aids and airports. I flew a DC9 on this trip, which is best suited for a commuter airplane or medium jet.

If you have followed previous RRs, skip to "Geography," and have fun.

For those who are new to this, Round Robins are published with the intent of having flight-simmers fly, look at the scenery, refresh geography knowledge, practice cross-country navigation, do some approaches at different airports over the world, and have FUN.

In this article you will encounter airport departure and runway numbers, VORs and ADFs enroute, two or three middle airport destinations for VFR or INST approach, and then return to your point of departure (round robin) for an INST or VFR approach, along with ILS and LOM frequencies, minimums,

Experienced flyers please note

Please be patient through all of the explanations, directions and extras. I direct this RR at newcomers to the flying world. I must stick to plain language.

procedures, etc. You will also get information on the scenery needed for the flight and where to get it, as well as a little background on the geography of the area.

I also suggest that you read the entire route a couple times before starting out, so that you'll have the flight plan clear in your mind.

Geography

This route is in the Saint Lawrence River and Seaway area. The Saint Lawrence River, the main outlet of the Great Lakes, is about 1,200 kilometers (about 760 miles) long. The entire Saint Lawrence River system, including the Great Lakes, is about 3,200 kilometers (about 2,000 miles) long.

In its upper course the river forms the boundary between Ontario and New York State. It then widens into Lake Saint Francis, which serves for a short distance as the border between Ontario and Québec before flowing totally in Québec for the remainder of its course.

At Montréal, the river widens to create Lac Saint-Louis. Ottawa is Canada's capital city and the home of the Canadian government. Toronto is Canada's largest city, with a population of 4.5 million.

Required scenery

Microsoft default and TORMONT4 (TORMONT4.ZIP can be found at <http://wings.ark.com> in the FS98/scenery section, or at other Flight Sim sites such as <ftp://wings.ark.com/wings/fs98/scenery/tormont4.zip>.)

Route

Toronto's Lester B. Pearson Int'l Airport → Montreal's Dorval Int'l Airport → Quebec's Jean Lesage Int'l Airport → Ottawa's Macdonald-Cartier → Toronto

See the map on the following page.

Begin

First leg

From:

Toronto Lester B. Pearson (CYYZ)

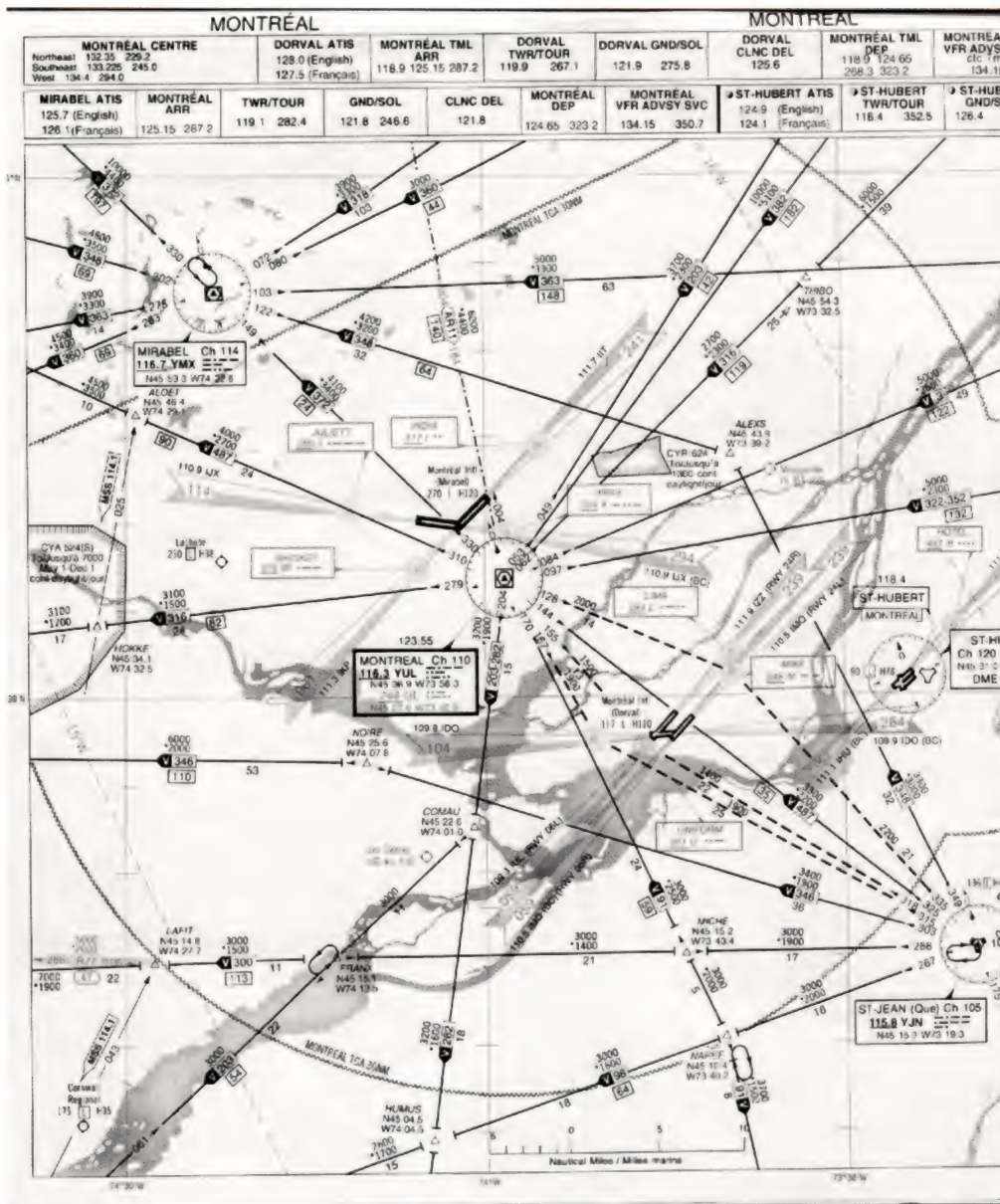
To:

Montreal Dorval (CYUL)

Distance 272 nm

- ➔ Set the clock to 16:30, Summer, in FS's **World | Time & Season** menu.
- ➔ Select Toronto Pearson runway (RWY) 06R under **World | Go to | Airport**.
- ➔ Dial in the Oshawa (OO) NDB frequency 391 and the Campbellford VOR (YCF) 113.50.
- ➔ Take off (T/O), climb runway heading to 3,000 ft, then turn right, homing on the OO NDB, and continue climbing to 20,000 ft.
- ➔ Once over the OO NDB, maintain heading (HDG) until you receive the YCF VOR, then track YCF to On Top.
- ➔ When over YCF, dial in and target the Smith Falls (YSH) NDB frequency 334.
- ➔ While enroute to YSH, you can also dial in the Montreal VOR (YUL) 116.30 on NAV 2 and the LOC (IUL) 109.3 on NAV 1. Set course to 059 on your NAV1 OBI in preparation for an ILS to RWY 06L at Dorval (actual course: 059, elevation: 117, RWY length: 11,000).

A Round Robin Adventure



➔ Over YSH, turn right HDG 084. Dial in and home the Uniform NDB 201 (you'll have no reception until 75 nm out of the YUL VOR), and begin a descent to 3,000.

➔ Approximately 30 nm out of the YUL VOR, turn right HDG 110 to intercept the LOC, and slow to approach speed.

➔ Intercept the LOC and complete approach.

➔ 5 nm back, you are cleared for a full stop to RWY 06L. Check that your gear is down.

Land Montreal

Second leg

From:
Montreal Dorval (CYUL)

To:
Quebec Jean Lesage (CYQB)

Distance 120 nm

➔ Set the clock to 19:30, Summer.

➔ Taxi to RWY 06L.

➔ Dial in the Trois-Rivieres (YRQ) NDB 205.

➔ T/O, climb RWY HDG to 16,000. Home the YRQ NDB.

Enroute, dial in the Quebec VOR (YQB) 112.8. Once you have reception on the YQB VOR, you are cleared direct to the VOR.

Round Robin Aviation Abbreviations

HDG = Heading

NDB = Non-directional Beacon

OBI= Omni-bearing Indicator

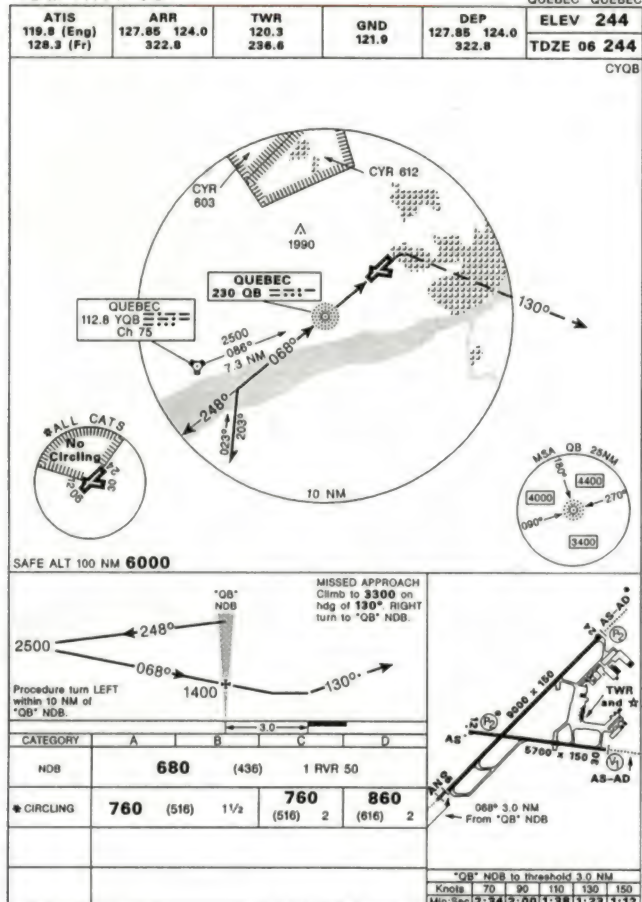
RWY = Runway

VOR = Very-high-frequency Omni-directional Range



NDB RWY 06

QUÉBEC/JEAN LESAGE INTL
QUÉBEC QUÉBEC



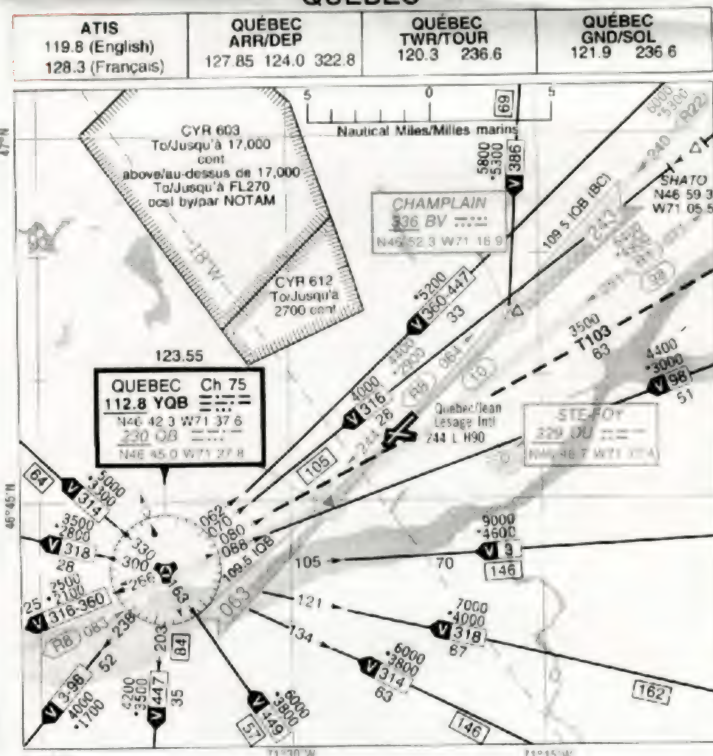
NDB RWY 06

N46 47 38 W71 23 29

VAR 18° W

QUÉBEC QUÉBEC
QUÉBEC/JEAN LESAGE INTL

QUÉBEC



- ➔ Taxi to and T/O RWY24, turn right climbing to 21,000, home the YRQ NDB to On Top.
- ➔ On top of YRQ, dial in and home the St-Felix-De-Valoi (VFX) NDB 260. Enroute, dial in the Mirabel VOR (YMX) 116.70. Upon reception proceed direct to YMX.

Enroute YMX, dial in the LOC 110.3 and set 320 on your NAV1 OBI, in preparation for an ILS approach to RWY 32 at Ottawa (actual course: 320, elevation: 374, RWY length: 9,650).

- ➔ Over Mirabel, begin descent to 2,600, dial in and home the Greeley NDB (YRR) 377 (see approach plate).
- ➔ Over the YRR NDB, turn left HDG 185 for 2 minutes, and maintain 2,600 altitude. Then, turn left to HDG 005 to intercept the LOC.
- ➔ Continue with approach. You are cleared for a full stop to RWY 32. Check that your gear is down.

Land Ottawa

- ➔ 50 nm out of YQB, dial in and home the Quebec (QB) NDB 230, and begin descending to 2,500 in preparation for an NDB approach to RWY 06 (actual HDG: 063, elevation: 244, and RWY length: 9,000).

NOTE: For this approach (check approach plate) you should be at 2,500 ft altitude, abeam the VOR, and 1,400 ft over the NDB. You can monitor your approach altitudes by dialing in the LOC 109.5 and setting 063 on your NAV 1 OBI.

- ➔ On top the NDB, steer HDG 063 and pick up the runway.
- ➔ 5 nm back, you are cleared for a full stop to RWY 06. Be sure your gear is down.

Make certain to see the map on the following page.

Land Quebec

Third leg

From:
Quebec Jean Lesage (CYQB)

To:
Ottawa Macdonald-Cartier (CYOW)

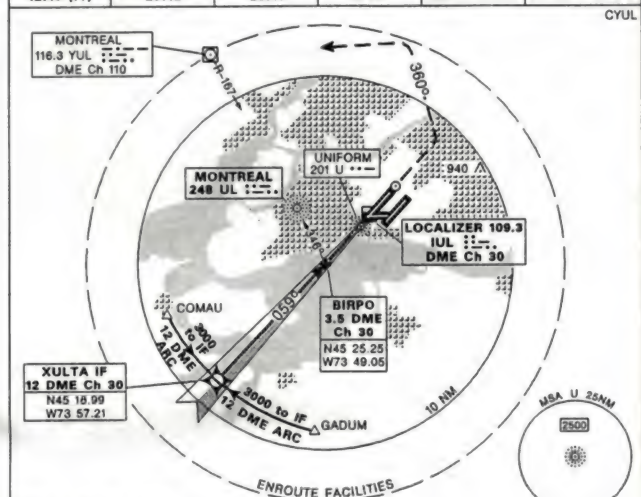
Distance 200 nm

- ➔ Set the clock to 07:00, Summer.
- ➔ Edit the Advanced Weather dialogue box (**World | Weather...**, after clicking "Use Advanced Weather dialogue" button under **Options | Preferences...**) so that the cloud coverage is "overcast" with the tops at 14,000 and base at 2,500; Winds are 12 knots at 290°; Visibility is 3 miles.
- ➔ Dial in the Trois-Rivieres (YRQ) NDB 205.

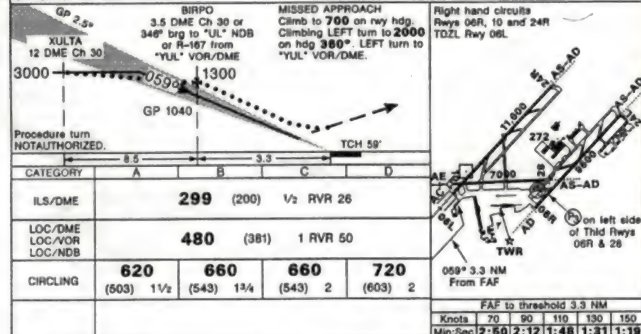
Full Throttle June-July 1998 www.ftmagazine.com

ILS RWY 06L

ATIS	ARR	TWR	GND	DEP	ELEV
128.0 (Eng) 127.5 (Fr)	118.9 125.15 287.2	119.9 267.1	121.9 275.8	118.9 124.65 268.3 323.2	117 TDZE 06L 99



SAFE ALT 100 NM 7400

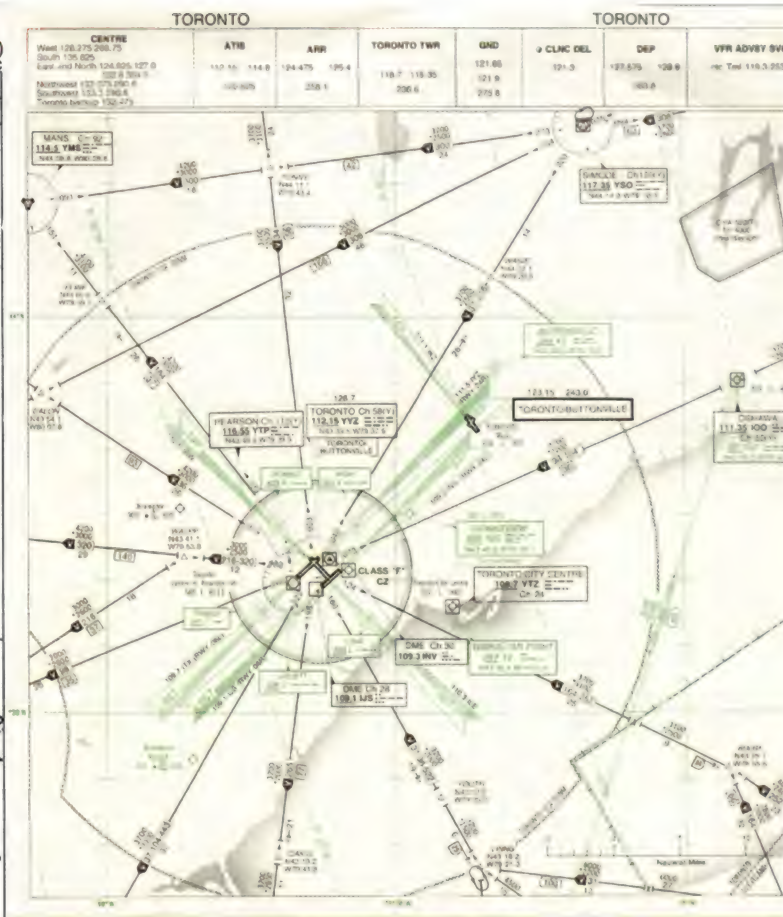


ILS RWY 06L

N45 28 05 W73 44 29 VAR 16° W MONTREAL QUEBEC
MONTREAL INTL (DORVAL)

TORONTO

TORONTO



Notes

1. Thank you to Chris Squire for test-flying the route. Thanks also to Peter Jacobson and Abacus for CoPilot, which was used for flight planning and maps, and to Henry Garbacz for the TORMONT scenery.
2. I flew the new DC9 (by Mike Vidal) with the excellent DC9 panel by David Durst. Both are available at the wings.ark.com site.



Feature Review

PhD—Propellerhead Design Panels for FS98

Review by Peter James

If you can't afford the \$170,000 price tag for a brand new 1997 Piper Archer III, then you can certainly fulfill your needs by purchasing one for \$12.00! I was glad to preview PhD's new Piper Warrior IIIs and Archer III. Since I have spent most of my real flying life in the left seat of the version II counterparts, I deemed myself qualified to take command of the FS98 versions.

I test flew three Piper Warriors and the Piper Archer "test Mule." The first thing that attracted me to this product line was the accolades I gave to the FS6 panels. The FS98 Piper panels are even more accurate and realistic. Details like rivets, all the twisty knobs, shadows and even wear and tear show up on these most-wonderful panels. The conventional Piper instrument panel design vanished when the new version III series was

released. It's a much more corporate-looking design, with a white background. There are even overhead engine starting switches in the real plane to make you think you're in a jet or fancy prop. Piper has fuel-injected the entire line and has done away with the conventional magnetos. Everything is done with rocker switches. You only need a key to open the doors.

By viewing screenshots you can see the detail that went into these panels. All the gauges, avionics and switches are exactly as they appear in the real plane. Even the autopilot, ADF, DME, transponder, Nav stack and Com radios are complete replicas of brand name avionics.

This is the first time I have seen this done since I used the photorealistic versions of ELITE. The only limitation this panel has compared to ELITE is the fact that FS98

doesn't allow greater smoothness on panel movements. However, the PhD panel allows usage of all knobs (like the altimeter and TAS) and dials found on the panel. I found it pleasing to move the mixture forward and backward. Just look at that knob!



You can pop on and off a great-looking yoke with a blank holder for David Druin's GPS 3.1 for FS98. This was another clever design. The entire panel is a masterpiece. It was designed for 1024x768, but I found it almost just as good in 800x600. If your computer is fast enough, the higher



PhD—Propellerhead Design Panels for FS98

resolution will allow you to read the tiniest printing, such as that on the airspeed TAS window.

Now the panel that made me laugh was the Archer Test Mule. Designed after an actual Archer III's prototype, this panel is loaded with markings and templates



indicating where things will eventually go. There is even a rag stuffed between the panel and the windshield!

Everything is functional and follows a layout similar to the Warrior.

The detail doesn't stop at the panel! Just look at the visual modeling of the aircraft! They are the very best Pipers I have ever seen! Over the years, very few designers have made any Pipers that look anything like an airplane, let alone a good one—so at last there are some stunningly real Pipers to view. And all the lighting and strobe effects were done well too.

A moving prop would have been nice to see also, but that's a minor quibble.

Before we discuss flying these planes, there is something to bring up. What is the difference between the Archer and the Warrior? Not much. The big change is in the engine. The Archer has a 180hp engine while the Warrior has a 160hp engine. If you have keen eyes, you'll notice the cowlings of the Archer is bulged to allow the bigger engine to fit nicely.

This engine difference results in a faster cruise speed over the Warrior. The Archer will cruise at 75% power at around 125kts, and the Warrior at around 110kts. The Archer is allowed 100 more pounds of useful load as well, and weighs 200 lbs. more than the Warrior.

Did PhD take all this into consideration? I'd have to say Yes. I test flew the Warrior one winter morning from AVP (Wilkes Barre, PA) nonstop to BOS (Boston). The flight was done on autopilot at 5,500ft then 7,500ft. It was a windy, choppy day using Real WX. I climbed sluggishly (per the real plane too!) at 700fpm up to cruise altitude. Once getting up there my power was reduced to around 2,400 or 2,500 rpm. I set my mixture, and my indicated airspeed was around 100kts. That was a little on the slow side, but you must realize indicated is slower. Actual true airspeed may have been 110 or so. My ground speed fighting a rare east wind was only 86kts. It was going to be a 3-hour

tour.

The flight went perfectly: clouds at 7,500 feet, then a clear, hazy sky over southern New England. My approach to Logan Airport in Boston was normal, and I made a visual landing on 4L. The descent, base and final felt darn close to the real thing. Base speed was planned for 75kts, and final slowed to 60kts. I plunked her down in the wind with a squeal and bounce. The trimming and pitch seemed realistic, though it was slightly sensitive. I had a friend try the same plane on his machine, and he kept bouncing it all over the runway. I didn't know why he found the plane so sensitive. I must blame it on not adjusting pitch sensitivities properly from within FS98. Overall, I'd say the flight quality is about 89% accurate.

A few days later I flew the Archer "Test Mule" from Denver International towards Boulder. Thinking FS98 had all the airports, I was angered to find the Boulder airfield didn't exist. But anyway, after a 20 minutes taxi to an active, I departed northwest bound. The

clear evening was very inviting, and the mountains loomed before me. After cruising at 8,500 feet, my airspeed was indicated nearly 120kts. Perfect! Climb rates in the Archer are good also, up to 1,100fpm.

After circling over the town of Boulder and not finding the airport, I decided to relive some instructing days and do some air work. I performed 45-degree steep turns, 60-degree turns and some stalls. All performed as the real airplane would. Stalls, however, wouldn't produce a spin. I tried time and time again, and the plane would just avoid any potential spins. I believe this is just an "FS98 thing" and not due to PhD.

Then I went back to the big airport for a landing. Some gusty snow squalled around at the time, and I did get rocked around quite a bit. It felt real. 70kts on final gave me a good landing.

Propellerhead has also released some beautiful panels for the default Cessna 182 RG. I am proud to review another quality product. The only tiny gripe, if there is one, is that the panel is so big and scaled that the outside view is limited. But this can easily be corrected by raising the lower edge of the outside view slightly. Also, the pitch sensitivity may be a tiny issue, but again, I think some tweaking of your control settings will solve any problems there. I give **PhD FS98 Piper** panels and planes a grand total of 94 out of 100 points! Purchase them and be proud to have them in your library—I doubt anyone else is going to rival these puppies!

You can find Propellerhead planes and panels at <http://www.propellerhead-phd.com>





Example scenes from PhD—Propellerhead Design Panels



Product Reviews

Pacific Islands

Escenario Suramerica Andes

VIP Classic Wings

Scenery China & More

German Airports 1

Pacific Islands

Review by Tim Dickens

The spectacular beauty of the Mariana Islands, located in the northern half of the Pacific Ocean between Hawaii and the Philippines, is captured in the **Scenery Pacific Islands** release from Pilots, GmbH. This area of the Pacific Ocean is conspicuously missing from the default FS98 scenery world. **Scenery Pacific**

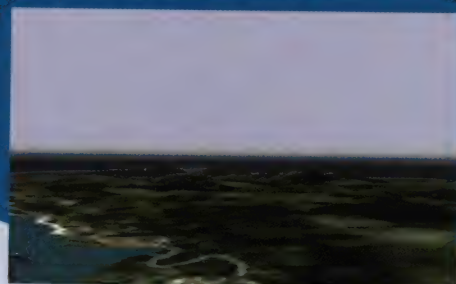
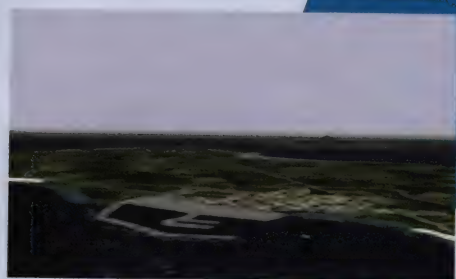
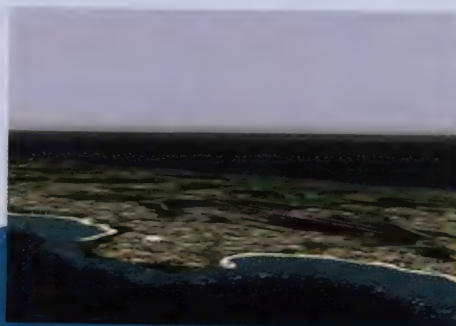
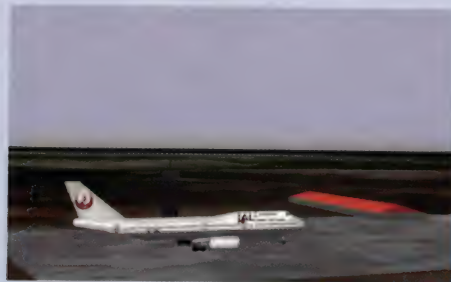
Islands covers the islands of Guam, Saipan, Tinian and the Northern Mariana Islands. Four airports and five heliports are detailed in the scenery package, which is the exact number existing in the real world.

The airports feature very realistic static 3-D aircraft, as well as custom-made terminals and jetways. All ILS and navaid frequencies, as they exist in the real world,

are provided for IFR landings. The airports blend nicely into the local terrain, creating a very convincing image from the air.

Realistic custom buildings enhance the view along the way.

The coastlines are rendered with an eye for detail. The textures created for **Scenery Pacific Islands** offer a very convincing rendition of the actual coastlines and look particularly realistic in FS98 3-D.

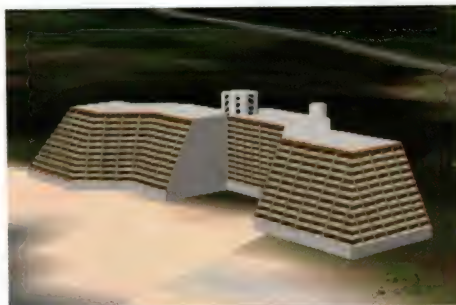


Product Reviews

Elevated terrain is also accomplished with equal detail.

The Pacific Islands scenery package is designed with FS98 3-D in mind, but is also compatible with FS95 and FS5.1. Six FS98 adventures are also included, recreating airline flights from Japan and Korea to locations within the scenery area.

For information on where you can find **Scenery Pacific Islands**, consult your favorite flight simulation software vendor or check the Web page at <http://www.austrodata.at/pilots>.



Scenery Pacific Islands

Pilots

Wipplingerstr, 24-26

A-1010 Vienna

Austria

Phone: +43 535-4010

Fax: +43 535-4010

Internet: www.austrodata.at/pilots.

E-mail: pilots_qesmbh@compuserve.com

Escenario Suramérica Andes

Review by Adam Howe

As the box says, "La aventura comienza en Suramérica" or "The adventure begins in South America." Being a little intimidated by the Spanish installation instructions, I proceeded with caution. I relaxed when I found two installation programs on the CD-ROM, one in English and one in Spanish.



Anyone interested in flying needs this program. Microsoft has done an admirable job in their quest to cover the globe with scenery, but there is always room for improvement. Playsoft's Escenario Suramérica Andes (Scenery South America Andes) is just such an improvement. Just compare Microsoft's 41 airports for all of South America to Escenario Suramérica Andes's 120+ airports. Playsoft's South America scenery covers the countries of Ecuador, Peru, Bolivia, Chile, Argentina (Andes) and Antartida (Antarctica).

One unexpected feature of the scenery is the Antarctica region, containing a couple airports (which I never knew existed) as well as a few outposts.

I found the scenery package as a whole to be a nice add-on to *Flight Simulator*. One drawback I noticed when flying is that the scenery seems to suddenly appear in front of you, instead of gradually appearing as you go along. This does not let you enjoy a vast view of the Andes Mountains or any other scenery for more than what seemed about five miles ahead of you. It simply displays water until you get



close enough. Aside from this small item, the scenery you do see is quite good. Personally, I would have liked to see more airport features, instead of the standard strip and tower a lot of scenery has. The major airports are quite nicely equipped with buildings and such, but it's the personal touches to scenery that make it special to everyone.

I definitely recommend this scenery to anyone, especially those interested in flying south of the equator. Installation was quick, easy and available in both English and Spanish. This scenery is complete with VOR and NDB information to make your flights seamless. Another great bonus comes in the manual. Even though it is in Spanish, the

maps, VOR, NDB and Airport listings, and occasional Airport diagrams are universal. Enjoy!

VIP Classic Wings

Review by Scott M. Slaughter

Are you tired of flying standard aircraft? Wouldn't you rather fly some real "classic" aircraft? If so, you must consider **VIP Classic Wings Volume 1**. When your company name of VIP stands for "Visually Incredible Panels," you better indeed have some incredible panels. Fortunately, the company uses the right name. All the aircraft in *VIP Classic Wings Volume 1* use instrument panels based on the actual cockpit display in the corresponding aircraft. In other words, most of the panels come from photos and realistic data.



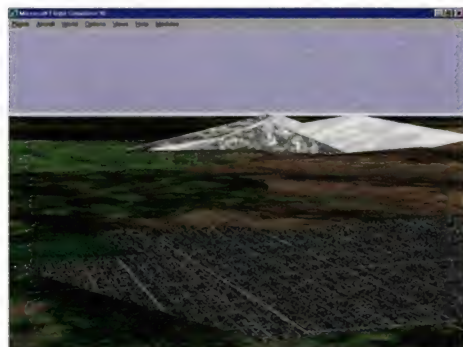
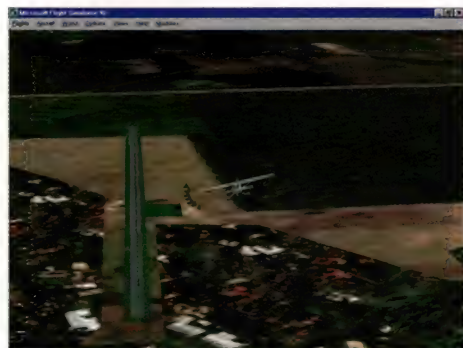
This is a good combination of civilian, military and commercial aircraft. Each aircraft is very convincing in quality, detail and flying. They're arguably among the most realistic looking aircraft currently available for *Flight Simulator*.

Realistic aircraft engine sounds

Realistic aircraft engine sounds add to the realism of the aircraft's appearance and instrument panels. You'll notice a difference in engine sounds from other FS programs because the VIP sounds were recorded professionally. Select from prop, turboprop and jet engine sounds (corresponding to the types of aircraft in *Classic Wings*).

The manual is another outstanding aspect of the package. *Classic Wings* includes a well written and illustrated 96-pages manual. It starts with very helpful hints on installing *Classic Wings*, information on instrument panels and even a tutorial on using *Classic Wings*.

Each of *Classic Wings*'s six aircraft types are explained in separate chapters. They include information on the history and physical characteristics of the aircraft. Even more importantly, the manual also includes very important tips on handling the aircraft



The instrument panels are impressive, and so are the aircraft themselves. All aircraft are ready to fly immediately—the program even includes the Microsoft converter program for FS98. *VIP Classic Wings* includes eight classic aircraft: the Douglas DC-3 Dakota, C-117 Super DC-3, Lockheed L-188 Electra, Lockheed P-3 Orion, C-130 Hercules, Shorts 360, Boeing 757 and DeHavilland DHC-1. Each of these has several paint schemes or variants, bringing the total number of aircraft to over fifty.

My favorite for fun is the DeHavilland DHC-1 Chipmunk. VIP includes a custom version of the Chipmunk you can fly for aerobatic fun. It features a more powerful engine and increased rudder and aileron control. My other favorite is the C-130 (liveries include the U.S. Coast Guard, Blue Angels, USMC and even Angola Airlines).

Escenario Suramerica Andes

Playsoft

Carrera 20. No. 39-331

Oficina 201

Santafe de Bogota Colombia

Phone: +571-338-30942

Fax: +571-245-3956

24-hr BBS: (612) 559-6197

Internet: www.playsoft.com.co

E-mail: playsoft@multi.net.co

Product Reviews

(flight characteristics, instruments, operations, etc.). You'll learn how to taxi, takeoff, fly and land the aircraft by reading the manual.

I also found the situations challenging, but not frustrating. My favorite was using the DC-3 Sprayer from Air Atlantique to find a suspected oil leak on the Thames river, in London. The objective is to find the oil leak, then spray the river from about 15 feet above the water—all while avoiding bridges, buildings and more. It's a neat challenge. Another good situation uses the DH Chipmunk of the VIP Stunt Team for some hot aerobatics.

Other bonuses in *VIP Classic Wings* include a fleet of twelve aircraft and scenery to use with Westwind-Cielo Virtual Airlines. The additional scenery features include custom-designed WestWind Cielo hangars at several airports. You'll also get an invitation to join the virtual airline. This is all explained in the manual.

Installation

Installing extra aircraft, panels and sound files can be a problem for many users, especially beginners. Fortunately, the installation program in *VIP Classic Wings* virtually installs everything for you. If you're over anxious, it is possible to click the wrong button and not properly install something (which I did), but just read the on-screen prompts carefully and you should not have any problem. You may install a single aircraft or install everything at one time. Then you can easily activate the new panels and sounds. You can also use the same program if you should wish to uninstall the aircraft.

Seriously consider this program if you enjoy Microsoft *Flight Simulator 95*. After using volume one, you'll be looking forward to *Classic Wings (Volume 2)* from the VIP Group as much as I am.

VIP Classic Wings

The PC Aviator Pty Ltd

219 Balaclava Road, Suite 6

North Caulfield, Victoria, 3161

Australia

Phone: 03-9532-8258

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Internet: www.pcaviator.com.au

E-mail: crew@pcaviator.com.au



Scenery China & More

Review by Brian Howard

China fascinates us as a land of mystery and wealth: The end of the silk road, manufacturer for the world, forbidden cities, ancient pyramids, birthplace of paper currency and gunpowder, den of dragons. Closed to most outsiders for decades, much is assumed but little is known by most people about this huge, diverse country occupying roughly the same amount of land as the continental United States.

Now you can virtually explore the skies, geography and history of China in Flight Simulator, thanks to Thomas Gierse and Andreas Gordes of Aerosoft, one of the more prolific publishers of FS add-ons. **Scenery China & More** offers nine-and-one-half million square kilometers of detailed scenery (including towns, waterways, roads and mountains), eleven highly detailed aircraft (from small jet fighters of the People's Liberation Army to commercial airliners) and many natural and cultural monuments (including Mt. Everest (highest mountain in the world), the Yangtsekiang river (one of the longest rivers—700 km—in the world), the Great Wall and Mao Zedong's mausoleum).

Scenery China ranges from coastal lowlands, past enormous rice fields, through interior deserts and beyond the highest mountains. The beaches are some of the best I've seen in FS scenery. The designers created very realistic geographic contours of most natural features of the landscape. All of China's 37 major airports are spread throughout the scenery, surrounded by the VORs and NDBs essential for finding one's way from one airfield to another. The airports feature everything you'd expect (landing lights, terminals, etc.), plus a few surprises which you'll have to see for yourself.

Rarely are the included planes a selling point for a scenery package, but **Scenery China** is an exception. The eleven aircraft are beautifully rendered with accurate flight models. Not only do they sport accurate paint

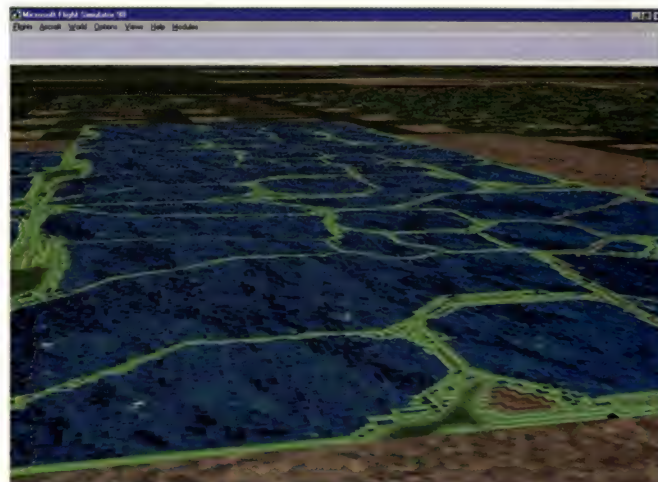
schemes and livery, but also realistic details, like stains from the engines' exhaust. Control of the North Vietnamese MiG-17 (the most-built airplane since WWII) was suitably sensitive. In contrast, the Ilyushin 14 (a sort of eastern DC-3) handled much more like a limousine than a sports model. This particular plane is styled on Chairman Mao's personal transport, right down to the plush furniture and vase of flowers in the cabin (switch to FS's virtual cockpit view and look backward into the plane to see it). **Scenery China** also provides Boeing 747 and 767s, Antonov 24s, MiG-17s, an Airbus 330, Ilyushin IL 62 and Yunshushi Y-7 (four prop planes, seven jets).

You'll find many interesting landmarks spread throughout **Scenery China**. Landscape formations include several of the world's highest mountains (Everest and K2). You'll also be able to fly over the Yellow River, one of the longest in the world, and the famed Great Wall of China. Other man-made monuments include the emperor's Forbidden City, the Chang Ping National Aviation Museum and the Empress Pagoda. Situation files instantly take you to many of these tourist sites.

The two adventures are a good introduction to Chinese airspace. One leads the pilot from London's Heathrow across Asia to Beijing. The other is a shorter flight from Beijing to the new Chek Lap Kok international airport in Hong Kong. These

adventures had a few small problems (one could wait a long time at the edge of 18L at Beijing Capital before being granted permission to depart), but overall were accurate and very detailed, even including a pushback from the terminal.

Like everything else, **Scenery China** isn't perfect. Some of the mountains seemed to ripple as I flew past. I noticed a few elevation conflicts. The adventures experienced a couple minor problems. But this is no more buggy than most other scenery



Product Reviews

packages I've flown. I encountered no major problems or conflicts with this scenery, even when simultaneously running other third-party FS add-ons, such as Abacus's Co-Pilot GPS instrument. Common problems are clearly explained by the FAQs at the end of the user manual.

I recommend this for pilots who have exhausted their current sceneries. The scope of **Scenery China** will keep anyone busy for many evenings. Other than the few small bugs I've hinted at, I had no technical troubles with **Scenery China**. Even the installation went smoothly (you'll need about 64 Megs for a full installation). The scenery itself isn't outstanding, but the objects placed in the scenery, the area covered, the included airplanes and the thrill of exploration add up to a very good package.

Scenery China & More

Aerosoft

Lindberghring 12

Flughafen Paderborn / Lippstadt

D-33142 Büren, Germany

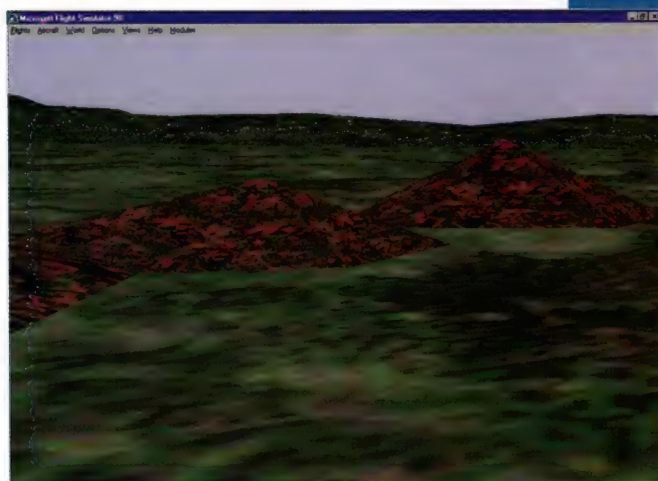
Phone: +49 (0) 2955 / 7603 - 10

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Internet: www.aerosoft.com

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German Airports I

Review by Phil Paschutine

If you're flying Microsoft's *Flight Simulator* (and I'm assuming most of our readers are), you can fly to almost any airport in the world with the default scenery. The trouble is, after visiting several default airports, they all begin to look alike. Many of the smaller airfields include only a rudimentary tower, if any buildings are provided at all.

If you're not satisfied with this, check out Aerosoft's **German Airports 1**. These airports feature many more infrastructure details than we've been accustomed to in scenery. The photorealistic rendering of the buildings handily supersedes the FS stock building textures.

Thanks to commercial and freeware scenery design programs, boasting custom 3-D objects and macros, and to a better understanding of macro programming and texture handling, designers are much more skilled when working with photographic textures and at designing very complex 3-D static objects. These advances are clearly evident in *German Airports 1*.

Commercial *Flight Simulator* scenery add-ons covering large flight areas (countries or continents) cannot include all the objects of any one airport. The needed data, such as airport pictures, architect plans, etc., would

be huge and sometimes difficult (or impossible) to get. Unless you're good friends with all the airport managers, you have to design with what you have available, usually airport charts taken from the Bottlang Airfield Manual or Jepp charts. Even if you managed to get all of the needed data, it would take several years to complete all of a country's airports with photorealistic textures and all the (static and dynamic) airport objects. The disk space needed to install the .BGL scenery files would also be a major drawback. Of course, the files could be read directly from a CD-ROM, but not everyone has a 24+ speed CD-ROM drive.

Releasing smaller groups of airports is an alternative to the larger flight zones. These can also include scenery exclude files where appropriate. *German Airports 1* is designed for use with BAO's *Europe 1*. It can also be used alone, but I find my *Europe 1* is greatly enhanced with *German Airports 1*—or is it the other way around?

This raises the layer question. *German Airports 1* must be assigned Layer 1 in the FS scenery library, and *Europe 1* must be Layer 2. If you take off from a UK field for a VFR flight (*Europe 3*), you must set the British scenery as Layer 1, then when flying over or landing in France or Belgium, switch *Europe 2* to Layer 1. Then, when flying into the *German Airports 1* region, you must make it Layer 1, and *Europe 1* Layer 2. (Maybe FS2000 will switch layers automatically? In the meantime, we'll have to juggle with the scenery layers settings.)

Installation

The install procedure is automatic. The multi-lingual install program will ask if you have *Europe*

1 already installed. Depending on your answer, scenery files with or without exclude .BGLs will be installed. You have no need to fuss with the layer settings during installation, as the program does that for you.



Manual and Charts

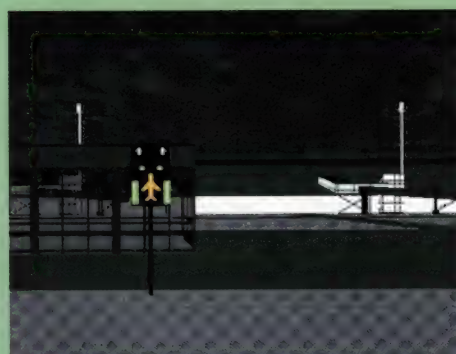
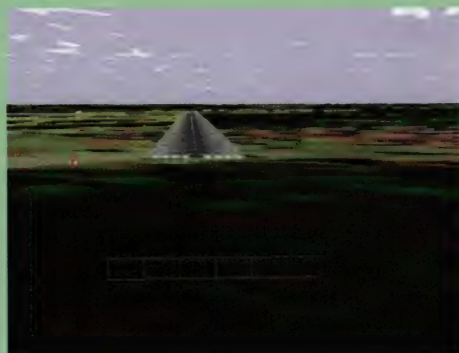
The manual is in English and German. The only fault is that the charts handbook lacks AREA and SIDS/STARS charts. These should be included with every airport scenery release! After all, *German Airports 1* has four major airports! (By the way, Aerosoft will soon be releasing *German Airports 2*, to be followed by several others in the series.)

Airports and Nav aids

German Airports 1 includes the following airports: Augsburg, Bayreuth, Egelsbach, Dresden, Friedrichshafen, Munich, Nuremberg and Stuttgart. Thomas Hirsch and Peter Hiermeier (whose Stuttgart airport was included in Papa Tango's *RealATC*, a fine piece of work) designed *German Airports 1* with no generic *Flight Simulator* buildings or textures. Each building is custom made and has its own texture(s). Many of the buildings have

German Airports 1 includes eight airports:

- ➔ Augsburg
- ➔ Bayreuth
- ➔ Egelsbach
- ➔ Dresden
- ➔ Friedrichshafen
- ➔ Munich
- ➔ Nuremberg
- ➔ Stuttgart



complex structures. The use of transparent glass panes allows the line of view not to be broken, like it is with FS default solid-colored windows.

German Airports 1 includes custom objects, such as dynamic windsocks, see-through panels and glass windows, fuel stations, small static airplanes and service vehicles (which lack elaborate textures, but I'm not complaining). Docking systems are also available. The wire frame localizer antennas could have been better designed. Taxiway signs can be seen in day/night conditions. The only missing objects are docked static heavies at the major airports. When on the ground, the pilot has a nice view of the outline of the airport buildings and trees, giving the feeling that he is in a true 3-D environment.

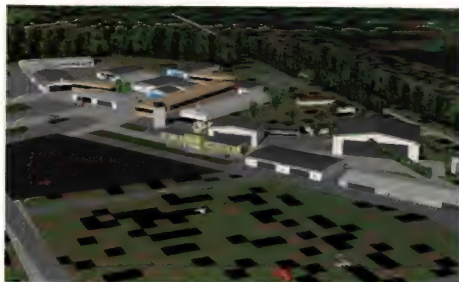
The lighting effects are well rendered, and Munich airport by night is a must see. Pilot controlled lighting (PCL) is also available, providing that you key in COM frequency 118.00.

All airports are set on the default *Europe 1* terrain base. This provides an excellent view of the airports from above and gives a uniform color to the scenery base. The nav aids include eight VORs, five NDBs and 13 ILS runways.

Bugs and Visual Oddities

Even the best software hides a few bugs, and *German Airports 1* is no exception. There are only a few, but I'll list what I found so you can't say I didn't warn you. The Augsburg and Stuttgart airports have misplaced airport reference points (ARP), and the tower at Augsburg is missing a COM frequency. As you can see, Egelsbach without *Europe 1* installed results in some very weird screen effects (this was experienced on two separate computers).





Conclusion

The *German Airports 1* scenery package from Aerosoft is an excellent add-on to the existing *Europe 1* scenery. The frame rate remains good throughout the flight area. The objects can be seen from far away and do not appear abruptly in front of you when you least expect them. My average frame rate with no 3DFX card is 8-10.5. I didn't have many disk accesses and the landings were pretty smooth. (You should know that my main test computer contains a Pentium 166, 24 MB RAM and an S3 video card.)

Despite some minor designing errors which should have been corrected during beta testing (after all, there are only eight airports!), *German Airports 1* is worth adding to one's scenery add-on collection. For more information on *German Airports 1*, you can contact Aerosoft at their Web site: <http://www.aerosoft.com>.

With *Europe 1* installed there is no such problem, but it seems that we are missing an exclude file here, as you can see the original *Europe 1* runway, taxiways and buildings. I did check several times, and yes, Egelsbach has no exclude file! Let us hope that Aerosoft will quickly upload that missing file to their Web site.

German Airports 1

Aerosoft

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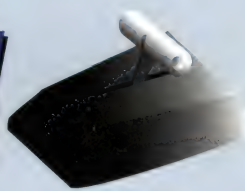
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WebWatch

Internet Sites for Simmers

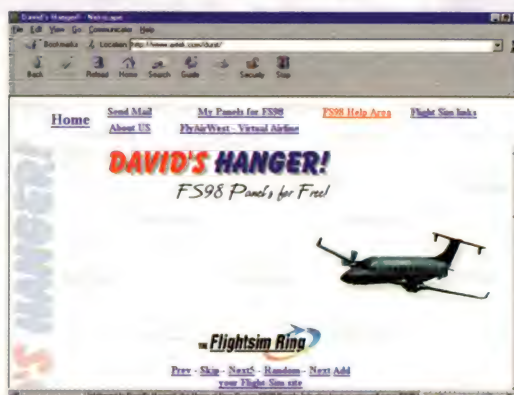
by Adam Howe

Attention *Full Throttle* readers: Flight 003 non-stop to the Internet is now boarding. Please power your computer on and log onto your server.

Today's flight will bring us into the exciting land of panels for the Microsoft *Flight Simulator*. Most of the panels we will be seeing on our journey through the Internet will be geared for FS98 with an occasional FS95 panel here and there. As with most FS-oriented sites, you may even find planes and scenery as well as panels.

David's Hanger!

The first layover on our excursion through the 'net brings us to <http://axtek.com/durst/>. You will find this site under construction, but don't let the signs scare you away. Too often we detour away from construction sites. This one is open and obstacle free. Here I found about 13 various panels ready to be placed into FS98. Probably the nicest feature about this page is the excellent Help page. It is not often you find documentation on the Internet with out having to give up a credit card number. Even though the page is not too busy with graphics, I was a bit lost at first finding the links to the downloads. I guess I'm used to graphic links versus text links (they are at the top of the page if you get lost!).



Here I found about 13 various panels ready to be placed into FS98

Varieties of panels

Welcome to <http://simflight.com/panels98>, where the panels are too plentiful to count. Offering a wide variety of panels for single, multiprop, Lear jet, military, jet and helicopters (yes, helicopters), you are sure to find a new panel to meet your liking here. It is always nice to see a panel before you spend the time downloading. Here you can! Just click on the image of the panel for a full-screen image. Be sure to check out this site for its FS links as well.



You're sure to find a new panel to meet your liking here: single, multiprop, Lear, military, jet and even helicopters.

Aircraft, scenery & panels

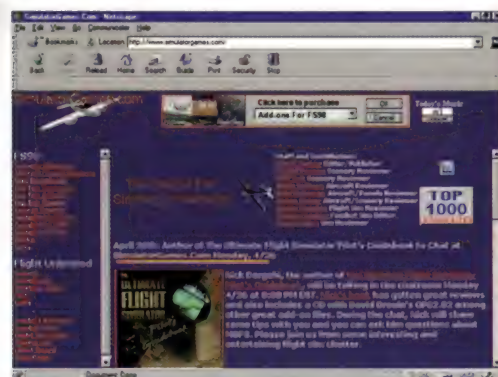
For our third destination, direct your browser to <http://checg.eng.himeji.tech.ac.jp/sanki/homel/flight/flight.htm>. Even though this will take a while to type in, it will be worth it. Disguised as a texture page for the Japan add-on scenery, it is also a good location to find aircraft, scenery and panels. The selection of panels is quite varied, but there are only a few aircraft and scenery. All in all, this site took a while to load, but with all the information and files available, it is worth the wait.



Although disguised as a texture page for the Japan add-on scenery, this site is also a good location to find aircraft, scenery and panels.

Site presents the "best" for FS

Our fourth stop on our Internet itinerary brings us to <http://www.simulatorgames.com> for a first-hand look at *Flight Simulator's* "Best of the best." This is an excellent site to find the top ten panels, aircraft and more. If you are interested in reviews, this is the place. Featured reviews critique the most common and popular FS add-on products. This site includes answers for common questions people (like myself) have asked in the past and are sure to ask in the future. If you think you are pretty smart, try the trivia. This site has ten FS questions separated into two games. One deals with general FS98 questions and one with FS add-on products.



This is an excellent site to find the top ten panels, aircraft, reviews and much more.

Just to see how you stack up, I was only able to answer three questions out of five on both sets—beat that!

Others worth considering

If you're tired and ready to take a nap, you can log off and disconnect. If you need more, set your browser to <http://www.cnet.org/~rongreg/index.html>. This page was a bit on the bland side, lacking graphics, but not bad. But you're not here for Web graphics; if you need panels, stop here. Another hot spot is <http://www.flylutz.com>. This site has a grand

selection of FS add-ons including aircraft, panels, scenery and other FS utilities. Be sure to check it out.

As most of you are probably aware, most FS98 panels require the *Microsoft Flight Shop Converter*, which can be downloaded free of charge from <http://www.microsoft.com/games/fsim/downloads>. The file to download is FS CONV98.EXE.

As our journey comes to an end once again, I would like to thank you for flying *Full Throttle* airlines, and please fasten your seat-belt, secure all belongings and return your trays to their upright position. I trust you have enjoyed your journey and hope you will be flying with us again soon. If you know of any interesting Web site, or if you are the Webmaster of an interesting FS site, please drop me a note at adam@ftmagazine.com.

Selected Aviation Acronyms

AFD - Airport & Facility Directory - a printed document containing airports and airport-related data that are pertinent for the pilot. It contains runway information (length, surface, orientation, etc.); types and frequencies of airport navigation and communication equipment; and fuel and service availability.

CAS - Calibrated Air Speed - the indicated airspeed adjusted for instrument variations and errors

FBO - Fixed Based Operator - an airport-based firm which refuels, repairs and maintains planes. This firm may also provide other services such as flight training or plane-for-hire.

GPS - Global Positioning System - a means of navigation based on the reception of satellite signals.

HSI - Horizontal Situation Indicator - an instrument which combines the functions of a compass and VOR or ILS instrument.

IAP - Instrument Approach Procedure - a procedure which specifies the route and altitude to follow when approaching an airport under instrument conditions.

IFR - Instrument Flight Rules - the set of FAA rules which a pilot must follow when flying an aircraft with complete coordination with air traffic control.

ILS - Instrument Landing System - a means of navigating to the vicinity of an airport runway using electronic instruments. This positions the aircraft at the proper alignment and altitude for subsequent landing.

METAR - Meteorological Report - hourly weather reports for a specific airport and formatted in a standard format.

RVR - Runway Visual Range - the distance which a pilot is able to see on approach to a runway.

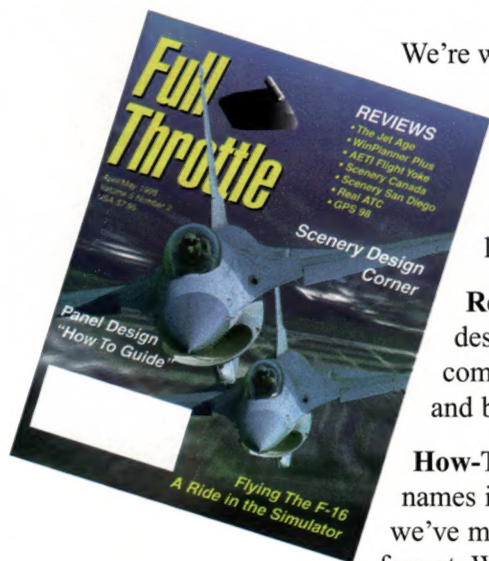
TAS - True Air Speed - the IAS adjusted for temperature and pressure

VFR - Visual Flight Rules - the set of FAA rules which a pilot must follow when flying an aircraft with minimal coordination with air traffic control.

VOR - Very high frequency Omni Range - a means of navigation based on the reception of VHF signals from a fixed based site.

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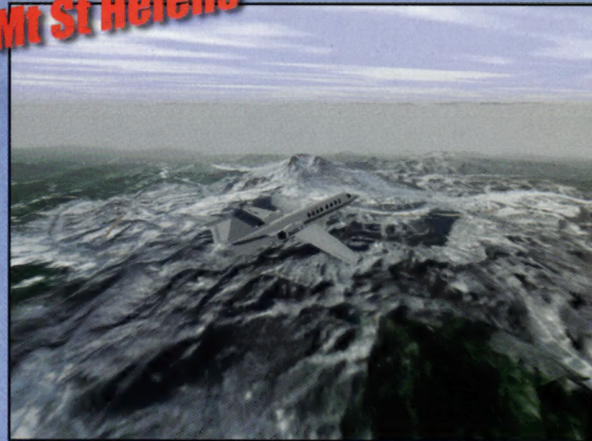
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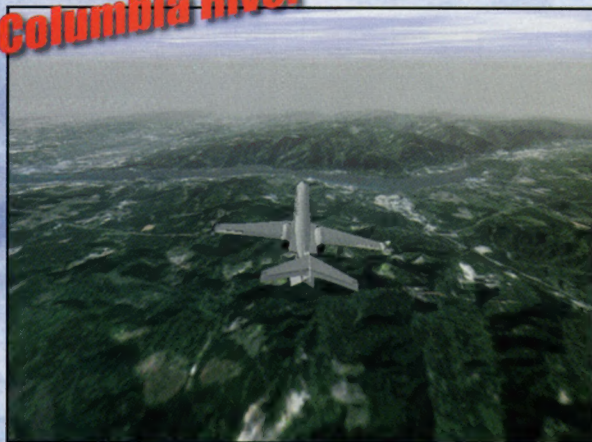
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